

## MYCOLOGY

UDC 582.284 (477)

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### ANNOTATED CHECKLIST OF HYGROPHORACEAE (AGARICALES, BASIDIOMYCOTA) OF UKRAINE

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<https://doi.org/10.34142/2708-5848.2020.22.2.01>

Hygrophoraceae is a family within Agaricales, which comprises 26 genera and approximately 690 agaricoid species, including ectomycorrhizal, lichen-forming, bryophilous, humus and litter decomposing fungi. Some of these species especially those from genera *Cuphophyllus*, *Hygrocybe*, *Neohygrocybe* and *Porpolomopsis* are associated with natural grasslands and show extreme sensitivity to the presence of nitrogen-containing fertilizers in their substrate. This makes them indicative species of grasslands of high conservation value.

While casual observations of Hygrophoraceae of Ukraine were incorporated in studies of agaricoid fungi as a whole, this family has never been in the focus of special research. Previously accumulated data on the diversity of Hygrophoraceae in Ukraine must be aggregated and revised.

We have summarized all available data on the occurrences of Hygrophoraceae in Ukraine, including published papers, open databases, citizen science observations, and the previously unpublished original collection materials. Also, we provide an original description of the rare European species *Haasiella venustissima* (Fr.) Kotl. & Pouzar ex Chiaffi & Surault, which is reported for the first time from the territory of Ukraine.

The resulting checklist of Hygrophoraceae of Ukraine includes 66 species. Leading genera are *Hygrophorus* (22 species), *Hygrocybe* (17) and *Arrhenia* (10); 5 species among them (*Hygrocybe punicea*, *Hygrocybe splendidissima*, *Neohygrocybe nitrata*, *Neohygrocybe ovina*, *Porpolomopsis calyptriformis*) are threatened and according to "IUCN Red List" considered "Vulnerable". The finds of 22 species in Ukraine were reported as doubtful. Carpathian Forests and Left-Bank Forest-Steppe are the phytogeographic regions with the highest known diversity of Hygrophoraceae; however, this may be explained by the sampling bias. In spite of the long history of investigations and rather big amount of data, the checklist may be significantly updated by further surveys of grassland habitats, wider using of molecular identification methods, and by implementation of the best practices in biodiversity data management, e.g. photographing of fresh fruit bodies, digitization and databasing of observations.

**Key words:** *agarics, literature review, review, citizen science, Haasiella venustissima, first record, Ukraine.*

Hygrophoraceae Lotsy is a family within Agaricales, which comprises 26 genera and approximately 690 species [1, 37, 69]. The concept of the family underwent significant changes during XIX – XXI centuries. Recent molecular studies have shown that some genera, previously considered as members of the Tricholomataceae, belong to Hygrophoraceae [42]. The family Hygrophoraceae is among the early diverging lineages of the Agaricales [23, 42, 47].

Hygrophoraceae show a wide range of ecological variability. There are ectomycorrhizal, bryophilous, humus and litter decomposers as well as lichen-forming fungi known among them [10, 38, 42]. Recent studies have shown that several species of *Hygrocybe* may form biotic interactions with the herbaceous

plants [20, 60]. Many of Hygrophoraceae (mostly representatives of *Hygrocybe*, *Cuphophyllus*, *Porpolomopsis*), are associated with natural grasslands and show extreme sensitivity to the presence of nitrogen-containing fertilizers in their substrate. This makes them indicative species of grasslands of high conservation value. [10, 42]. *Porpolomopsis calyptriformis* (Berk.) Bresinsky is treated as "rare" in the Red Data Book of Ukraine. As much as 30 species of Hygrophoraceae are included in the IUCN Red List of Endangered Species [12, 32].

Hygrophoraceae of Ukraine have never been in the focus of special research. However, they were treated within studies of agaricoid fungi as a whole. As an exception, A.E. Kovalenko revised several specimens from the

herbarium of M.G. Kholodny Institute of Botany (KW–M) within his study on Hygrophoraceae of former USSR [38]. The first observed records of the Hygrophoraceae from Ukraine was made in 1869 by E.G. Borschow in Chernihiv region (North-East of Ukraine), where *Hygrocybe* (*Hygrophorus*) *conica*, *H. miniata* and *Hygrophorus eburneus* were reported [11]. In 1907, G. Bobyak recorded 14 species of Hygrophoraceae from Galicia and Bukovyna (Western Ukraine), including rare species like *Hygrophorus* (*Agaricus*) *russula* and *Neohygrocybe* (*Hygrophorus*) *nitrata* [9]. Among a few studies, published in the first half of XX century, one of the most informative on diversity of Ukrainian Hygrophoraceae was “Hymenomycetes Carpatorum orientarium” written by A. Pilat, where 11 species were reported for the Ukrainian Carpathians [49]. In the second half of the century, M.Ya. Zerova, I.M. Soldatova, I.O. Dudka, S.P. Vasser, I.S. Besedina, K.K. Karpenko and others significantly widened the list of Ukrainian macromycetes, including Hygrophoraceae [8, 13–15, 34–36, 63, 65, 67, 68, 70, 71]. The “The Key to Fungi of Ukraine” by M.Ya. Zerova. et al.

summarized all the data on Hygrophoraceae of Ukraine available in 1979, and reported 49 species [71].

Since “The Key...” has been released, there were no more generalizations of data on diversity of Hygrophoraceae in Ukraine. Meanwhile, studies of agarics of Ukraine, which include Hygrophoraceae species, continue up to these days [13–16, 26, 28, 39, 44, 46]. Citizen science, which demonstrates the global rise during last two decades, has been started to engage in mycological research [24, 27]. Finally, some occasional observations of Hygrophoraceae, kept in local herbaria, remain unpublished.

The main objectives of this study are summarizing all the data on observations of Hygrophoraceae in Ukraine, involving published data, data from scientific databases, citizen science observations, and collection materials and preparing a checklist of Hygrophoraceae of Ukraine. Herein we provide a comprehensive checklist of Hygrophoraceae of Ukraine, as well as the original description of the rare European species *Haasiella venustissima* (Fr.) Kotl. & Pouzar ex Chiaffi & Surault, which is reported for the first time from the territory of Ukraine.

## MATERIALS AND METHODS

The checklist was compiled based on all available published data on Hygrophoraceae species from the territory of Ukraine, as well as collections kept in herbarium of V.N. Karazin Kharkiv National University herbarium (CWU(MYC)) and M.G. Kholodny Institute of botany NAS of Ukraine (KW–M), the first collection was studied directly, the second by using the online database “Fungi of Ukraine” [3]. We also incorporated verifiable (accompanied by high-quality photographs for species, which can be identified using macrostructures) observations from citizen science projects “iNaturalist” and “UkrBin”, as well as Facebook-group “Fungi of Ukraine” [17, 31, 61].

The concept of species in the checklist follows the Index Fungorum; the concept of family follows the classification, published in the “Outline on Fungi and fungus-like taxa” [37, 69].

Distribution data for the Hygrophoraceae species were aggregated from publications, herbarium specimens and citizen science observations and generalized to the level of phytogeographic regions according to the “Flora

Fungorum Ucrainicae” [25]. Both names and accepted abbreviations of regions are translated following Akulov et al. approach [3], with some additions: KFS – Kharkiv Forest-Steppe, MRF – Middle-Russian Forests; PF – Precarpathian Forests, RF – Roztocze Forests, SP – Small Polissya, SGMS – Starobilsk Gramineous-Meadow Steppe, TR – Transcarpathian Region, WUF – West-Ukrainian Forests.

The microscopic structures of *Haasiella vetustissima* were observed in dried material. Microscopic sections of lamellae were made at about 1/2 radius of the pileus and examined using Congo-Red in 10% solution of ammonia. Data on spore size are based on 15 spore measurements. Specimen was collected by O. Prylutskyi and deposited in the Herbarium of the V.N. Karazin Kharkiv National University, Kharkiv, Ukraine – CWU(MYC). In the descriptions the following abbreviations are used: L = number of lamellae reaching stipe; l = number of short lamellae (not reaching stipe) between two long ones; Q = length divided by width.

## RESULTS

The resulting checklist includes 66 species, which belong to 13 genera of Hygrophoraceae, reported for the territory of Ukraine. Twenty-two species are reported as doubtful findings. Original description, alongside with the data on current distribution of the *Haasiella venustissima* (Fr.) Kotl. & Pouzar ex Chiaffi & Surault are provided.

***Haasiella venustissima* (Fr.) Kotl. & Pouzar ex Chiaffi & Surault, Bull. trimest. Soc. mycol. Fr. 112: 127 (1996)**

### Synonymy:

***Agaricus venustissimus* Fr., Monogr. Hymenomyc. Suec. (Upsaliae) 2(2): 289 (1863)**

***Clitocybe venustissima* (Fr.) P. Karst., Bidr. Känn. Finl. Nat. Folk 32: 62 (1879)**

***Gerronema venustissimum* (Fr.) Singer, Sydowia 15(1-6): 51 (1962) [1961]**

***Haasiella venustissima* (Fr.) Kotl. & Pouzar, Česká Mykol. 20(3): 135 (1966)**

***Omphalia venustissima* (Fr.) Quél., Enchir. fung. (Paris): 21 (1886)**

***Omphalina venustissima* (Fr.) M. Lange, Nordic Jl Bot. 1(5): 695 (1981)**

Basidiomata omphalinoid to clitocyboid, gregarious. Cap 10–45 cm in diameter, convex, then plane, smooth to minutely pubescent, slightly hairy towards margin, dry, yellow to bright orange, discoloring towards margin to pale yellow. Gills decurrent, distant,  $L = 20\text{--}27$ ,  $l = 40\text{--}60$ , pale to bright orange, discoloring when drying to bright orange. Stem  $20\text{--}50 \times 4\text{--}7$  mm, equal to slightly widened towards base, smooth to fibrillose, minutely granulose in upper part, white pubescent in lower part, concolourous with cap. Flesh white to pale yellow. Smell weak, pleasant.

Spores  $5.2\text{--}6.1 (-7.0) \times (3.3\text{--}) 3.6\text{--}4.3 \mu\text{m}$ ,  $Q = 1.38\text{--}1.41\text{--}1.58$ , ellipsoid, sub-ovate, smooth, hyaline, without iodine reaction. Basidia predominantly 2-spored,  $33\text{--}37 \times 3.4\text{--}4.6 \mu\text{m}$ , with a sterigmata  $5.9\text{--}9.2 \mu\text{m}$  long, clampless. Hymenial cystidia absent.

**Material examined:** Ukraine, Kyiv region, Kaharlyk district, Rzhyschiv city vicinity, deciduous ravine forest with *Alnus glutinosa*, *Acer platanoides*,

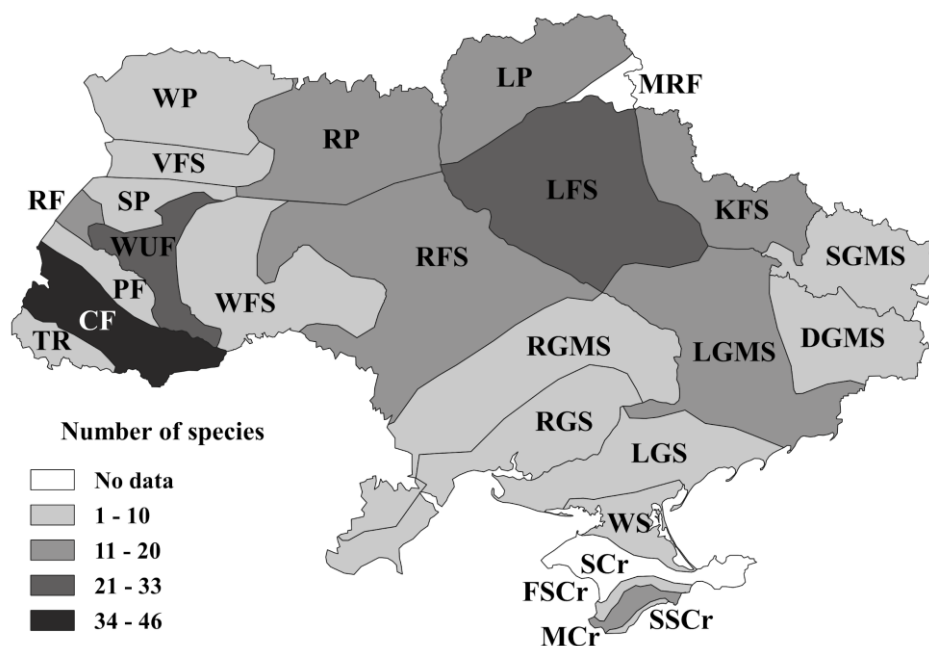


Fig. 1. Distribution of known observations of Hygrophoraceae in Ukraine.

CF – Carpathian Forests, DGMS – Donetsk Gramineous-Meadow Steppe, FSCr – Forest-Steppe Crimea, KFS – Kharkiv Forest-Steppe, LFS – Left Bank Forest-Steppe, LGS – Left Bank Gramineous Steppe, LGMS – Left Bank Gramineous-Meadow Steppe, LP – Left Bank Polissya, MRF – Middle-Russian Forests, MCr – Mountain Crimea, PF – Precarpathian Forests, RF – Roztocze Forests, RFS – Right Bank Forest-Steppe, RGS – Right Bank Gramineous Steppe, RGMS – Right Bank Gramineous-Meadow Steppe, RP – Right Bank Polissya, SP – Small Polissya, SSCr – South Seaside of Crimea, SGMS – Starobilsk Gramineous-Meadow Steppe, SCr – Steppe Crimea, TR – Transcarpathian Region, VFS – Volyn

Forest-Steppe, WFS – Western Forest-Steppe, WP – Western Polissya, WUF – West-Ukrainian Forests, WS – Wormwood Steppe.

*Betula pendula*, *Populus tremula*, *Sambucus nigra*, *Corylus avellana* on clay soil, on fine woody debris and roots of *Sambucus nigra*, 49.9609515 N, 31.1191692 E, 16.10.2020 (CWU(MYC)8447).

There was a citizen science observation from Hryshko National Botanical Garden, Kyiv city, 10.11.2020, which visually resembles *H. venustissima*, but the specimen is absent. See Annotated checklist for more details.

**Distribution:** Austria, Belgium, Bulgaria, Croatia, Czech Republic, Denmark, France, Germany, Italy, Slovakia, Spain, Sweden, Switzerland, The Netherlands, Ukraine, United Kingdom, USA (doubtful finding) [18, 19].

*H. venustissima* is indicated as a very rare European endemic species, more or less restricted to Central Europe, whose population is strongly declining. The species is proposed to include to the IUCN Red List of Threatened Species as Endangered because of an estimated

reduction of more than 50% over the last 50 years (three generations), a decline projected to continue and caused by habitat loss and nitrification of potential and existing habitats [19].

### Annotated checklist of Hygrophoraceae of Ukraine

An Annotated checklist is organized according to the following scheme: full Latin name with the nomenclatural citation – basionym and the most common synonyms / publications where the species were mentioned, divided by semicolon symbols for each name it was mentioned under, followed by shortened reference links to citizen science observations (if present); distribution as a list of phytogeographic regions according to “Flora Fungorum Ucrainicae” [25] where species were mentioned; known herbarium specimens.

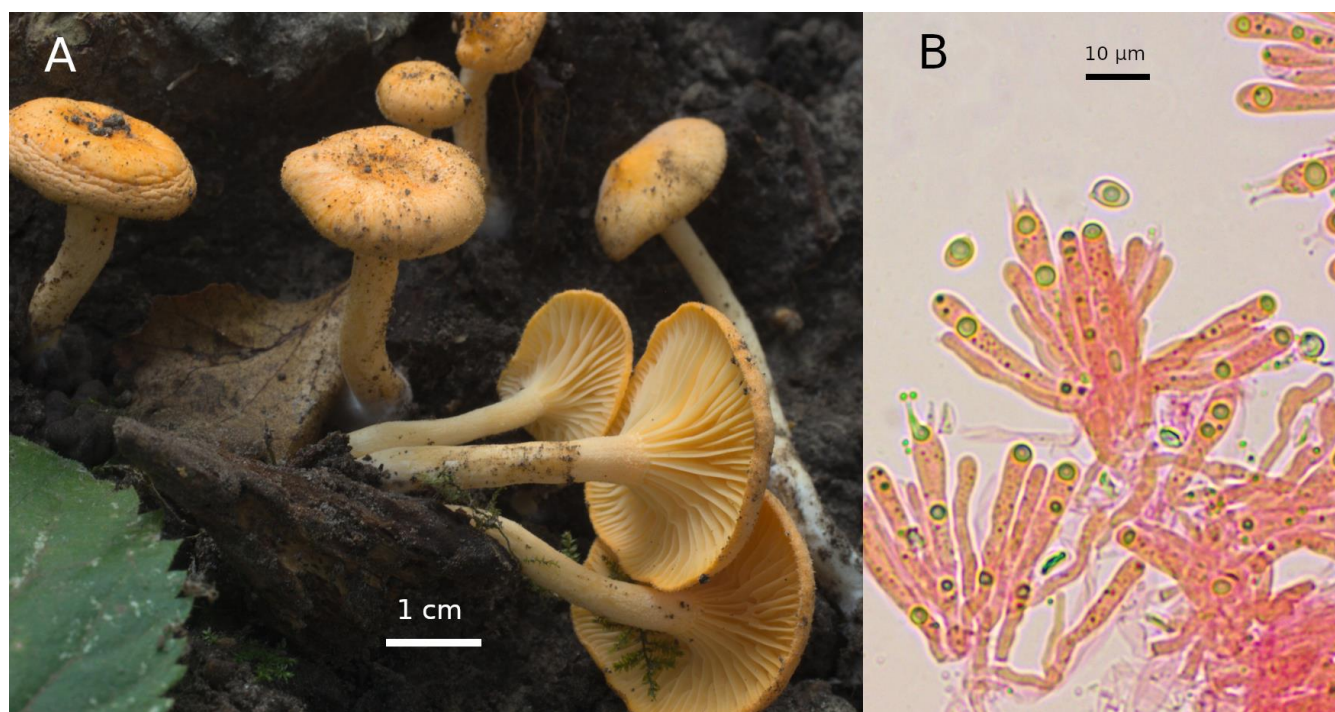


Fig. 2. *Haasiella venustissima*. A – basidiomata; B – basidia and basidiospores in Congo-Red solution.

**Gen. *Ampulloclitocybe* Redhead, Lutzoni, Moncalvo & Vilgalys**

1. *Ampulloclitocybe clavipes* (Pers.) Redhead, Lutzoni, Moncalvo & Vilgalys, *Mycotaxon* **83**: 36 (2002) – *Agaricus clavipes* Pers., *Syn. meth. fung.* (Göttingen) **2**: 353 (1801); *Clitocybe clavipes* (Pers.) P. Kumm., *Führ. Pilzk. (Zerbst)*: 124 (1871) / [28, 39, 44, 46, 54, 55, 61] as *Ampulloclitocybe clavipes*; [9, 48] as *Agaricus clavipes*; [14–20] as *Clitocybe clavipes*; citizen science observations – [<https://bit.ly/3gCyINc>; <https://bit.ly/2KcIBVD>; <https://bit.ly/2LybDjn>]; distribution – CF, KFS, LFS, LP, PF, RF, RFS, RGMS, RP, SP, VFS, WUF; collections – CWU(MYC)7276; KW–M54513, KW–M54514, KW–M54515, KW–M54516, KW–M54517, KW–M54518, KW–M54519, KW–M54520, KW–M54521, KW–M54661, KW–M54662, KW–M54663, KW–M54664, KW–M54665, KW–M56529.

**Gen. *Arrhenia* Fr.**

2. *Arrhenia cupularis* (Wahlenb.) Fr., *Summa veg. Scand.*, Sectio Post. (Stockholm): 312 (1849) / [10, 49]; distribution – WUF, possibly PF, RF, SP.
3. *Arrhenia epichysium* (Pers.) Redhead, Lutzoni, Moncalvo & Vilgalys, *Mycotaxon* **83**: 47 (2002) – *Omphalia epichysium* (Pers.) P. Kumm., *Führ. Pilzk. (Zerbst)*: 107 (1871); *Omphalina epichysium* (Pers.) Quél., *Enchir. fung.* (Paris): 43 (1886) / [28] as *Arrhenia epichysium*; [49] as *Omphalia epichysium*; [71] as *Omphalina epichysium*; citizen science observations – [<https://bit.ly/3n8mkXA>]; distribution – CF, RGS.
4. *Arrhenia griseopallida* (Desm.) Watling, *Notes R. bot. Gdn Edinb.* **45**(3): 553 (1989) [1988] – *Leptoglossum griseopallidum* (Desm.) Jamoni, *Funghi e Ambiente* **52**: 5 (1990); *Omphalina griseopallida* (Desm.) Quél., *Enchir. fung.*: 44 (1886) / [46] as *Arrhenia griseopallida*; [14] as *Leptoglossum griseopallidum*; [16, 22, 25, 27, 36, 47, 50, 51] as *Omphalina griseopallida*; citizen science observations – [<https://bit.ly/3qRUjG8>; <https://bit.ly/3qJZLuu>];

<https://bit.ly/2W8TJWi>; <https://bit.ly/3meVV98>]; distribution – FSCr, KFS, LFS, LGS, LGMS, MCr, PF, RGMS, RP, SSCr.

5. *Arrhenia onisca* (Fr.) Redhead, Lutzoni, Moncalvo & Vilgalys, *Mycotaxon* **83**: 47 (2002) – *Omphalia oniscus* (Fr.) Gillet, *Hyménomycètes* (Alençon): 297 (1876) [1878]; *Omphalina oniscus* (Fr.) Quél., *Enchir. fung.* (Paris): 43 (1886.) / [28] as *Arrhenia onisca*; [49] as *Omphalia oniscus*; [71] as *Omphalina oniscus*; distribution – CF.
6. *Arrhenia philonotis* (Lasch) Redhead, Lutzoni, Moncalvo & Vilgalys, *Mycotaxon* **83**: 48 (2002) – *Omphalia philonotis* (Lasch) Quél., *Mém. Soc. Émul. Montbéliard*, Sér. 2 **5**: 239 (1872); *Omphalina philonotis* (Lasch) Quél., *Enchir. fung.* (Paris): 43 (1886) / [28] as *Arrhenia philonotis*; [49] as *Omphalia philonotis*; [71] as *Omphalina philonotis*; distribution – CF.
7. *Arrhenia retiruga* (Bull.) Redhead, *Can. J. Bot.* **62**(5): 873 (1984) / [46]; distribution – TR, WUF; collections – CWU(MYC)8449
8. *Arrhenia rickenii* (Hora) Watling, *Notes R. bot. Gdn Edinb.* **45**(3): 553 (1989) [1988] / [46]; distribution – WUF.
9. *Arrhenia rustica* (Fr.) Redhead, Lutzoni, Moncalvo & Vilgalys, *Mycotaxon* **83**: 48 (2002) – *Omphalia rustica* (Fr.) Quél., *Mém. Soc. Émul. Montbéliard*, Sér. 2 **5**: 100 (1872); *Omphalina rustica* (Fr.) Quél., *Enchir. fung.* (Paris): 43 (1886) / [16, 46] as *Arrhenia rustica*; [49] as *Omphalia rustica*; [21, 63, 68, 71] as *Omphalina rustica*; citizen science observations – [<https://bit.ly/3qU1ihU>; <https://bit.ly/37ShaZq>]; distribution – CF, LFS, LGS, LGMS, RFS, WS, WUF.
10. *Arrhenia spathulata* (Fr.) Redhead, *Can. J. Bot.* **62**(5): 876 (1984) / [3, 35, 51, 52]; citizen science observations – [<https://bit.ly/3oJo6ik>]; distribution – KFS, LFS.
11. *Arrhenia umbratilis* (Fr.) Redhead, Lutzoni, Moncalvo & Vilgalys, *Mycotaxon* **83**: 48 (2002) – *Omphalia umbratilis* (Fr.) Gillet, *Hyménomycètes* (Alençon): 299 (1876) [1878]; *Omphalina umbratilis* (Fr.) Quél., *Enchir. fung.* (Paris): 45 (1886) / [28] as *Arrhenia umbratilis*; [49] as *Omphalia umbratilis*; [71] as *Omphalina umbratilis*; distribution – CF.



**Gen. *Cantharellula* Singer**

12. *Cantharellula umbonata* (J.F. Gmel.) **Singer**, *Revue Mycol.*, Paris **1**: 281 (1936) / [6, 14, 15, 53, 55, 61]; citizen science observations – [<https://bit.ly/3na5bNf>; <https://bit.ly/3mgkD9a>]; distribution – CF, KFS, LFS, LP, RP, WP.

**Gen. *Chrysomphalina* Cléménçon**

13. *Chrysomphalina chrysophylla* (Fr.) **Cléménçon**, *Z. Mykol.* **48**(2): 203 (1982) – *Omphalia chrysophylla* (Fr.) Gillet, *Hyménomycètes* (Alençon): 296 (1876) [1878]; *Omphalina chrysophylla* (Fr.) Murrill, *N. Amer. Fl.* (New York) **9**(5): 346 (1916) / [28, 45] as *Chrysomphalina chrysophylla*; [49] as *Omphalia chrysophylla*; [71] as *Omphalina chrysophylla*; distribution – CF.

**Gen. *Cuphophyllus* (Donk) Bon**

14. *Cuphophyllus fornicatus* (Fr.) **Lodge, Padamsee & Vizzini**, in Lodge et al., *Fungal Diversity* **64**(1): 80 (2013) [2014]; *Hygrophorus fornicatus* Fr., *Epicr. syst. mycol.* (Upsaliae): 327 (1838) [1836-1838] / [29] as *Cuphophyllus fornicatus*; [71] as *Hygrophorus fornicatus*; citizen science observations – [<https://bit.ly/2WcPZDk>; <https://bit.ly/2LyHO1Z>]; distribution – CF.
15. *Cuphophyllus pratensis* (Fr.) **Bon**, *Docums Mycol.* **14** (56): 10 (1985) [1984] – *Camarophyllus pratensis* (Fr.) P. Kumm., *Führ. Pilzk.* (Zerbst): 118 (1871); *Hygrophorus karstenii* Sacc. & Cub., *Syll. fung.* (Abellini) **5**: 401 (1887); *Hygrophorus pratensis* (Fr.) Fr., *Anteckn. Sver. Ätl. Svamp.*: 46 (1836) / [28, 38, 46, 55] as *Cuphophyllus pratensis*; [5, 14, 22] as *Camarophyllus pratensis*; [71] as *Hygrophorus karstenii*; [9, 71] as *Hygrophorus pratensis*; citizen science observations – [<https://bit.ly/2IJ5EqE>; <https://bit.ly/3a8ScYC>; <https://bit.ly/2LyHO1Z>]; distribution – CF, KFS, LFS, LGMS, RF, SGMS, WUF.
16. *Cuphophyllus virgineus* (Wulfen) **Kovalenko**, in Nezdoininogo, *Opredelitel'*

*Gribov SSSR* (Leningrad): 37 (1989) – *Camarophyllus niveus* (Scop.) Wünsche, *Die Pilze*: 115 (1877); *Camarophyllus virgineus* (Wulfen) P. Kumm., *Führ. Pilzk.* (Zerbst): 117 (1871); *Cuphophyllus subradiatus* (Schumach.) Bon, *Docums Mycol.* **14** (56): 11 (1985) [1984]; *Hygrocybe virginea* (Wulfen) P.D. Orton & Watling, *Notes R. bot. Gdn Edinb.* **29** (1): 132 (1969); *Hygrophorus niveus* (Scop.) Fr., *Epicr. syst. mycol.* (Upsaliae): 327 (1838) [1836-1838]; *Hygrophorus virgineus* (Wulfen) Fr., *Epicr. syst. mycol.* (Upsaliae): 327 (1838) [1836-1838] / [28, 38, 39, 45, 46] as *Cuphophyllus virgineus*; [63, 65, 71] as *Camarophyllus niveus*; [21, 22, 67, 68] as *Camarophyllus virgineus*; [38] as *Cuphophyllus subradiatus*; [3] as *Hygrocybe virginea*; [57] as *Hygrophorus niveus*; [9, 71] as *Hygrophorus virgineus*; citizen science observations – [<https://bit.ly/2IJ5EqE>; <https://bit.ly/37bLpV>; <https://bit.ly/3r0loqP>; <https://bit.ly/3oOsi0o>; <https://bit.ly/3gQcN5i>; <https://bit.ly/3mcT8gY>; <https://bit.ly/2LyHO1Z>; <http://bit.ly/3r8VEbL>]; distribution – CF, LFS, LGMS, RF, RP, SGMS, SP, TR, WFS, WUF.

**Gen. *Gliophorus* Herink**

17. *Gliophorus irrigatus* (Pers.) **A.M. Ainsw. & P.M. Kirk**, *Index Fungorum* **23**: 1 (2013) – *Hygrocybe irrigata* (Pers.) M.M. Moser, in Gams, *Kl. Krypt.-Fl.*, Edn 2 (Stuttgart) **2b**: 45 (1955) / [46] as *Gliophorus irrigatus*; [28, 45] as *Hygrocybe irrigata*; distribution – CF, WUF.
18. *Gliophorus laetus* (Pers.) **Herink**, *Sb. severočesk. Mus., Hist. Nat.* **1**: 84 (1958) – *Hygrocybe laeta* (Pers.) P. Kumm., *Führ. Pilzk.* (Zerbst): 112 (1871); *Hygrophorus laetus* (Pers.) Fr., *Epicr. syst. mycol.* (Upsaliae): 329 (1838) [1836-1838] / [38, 39] as *Gliophorus laetus*; [28, 58] as *Hygrocybe laeta*; [9, 71] as *Hygrophorus laetus*; distribution – CF, RF, WUF.
19. *Gliophorus psittacinus* (Schaeff.) **Herink**, *Sb. severočesk. Mus., Hist. Nat.* **1**: 82 (1958) – *Hygrocybe psittacina* (Schaeff.) P. Kumm., *Führ. Pilzk.* (Zerbst): 112 (1871);

*Hygrophorus psittacinus* (Schaeff.) Fr., *Epicr. syst. mycol.* (Upsaliae): 332 (1838) [1836-1838]; *Hygrophorus sciophanus* (Fr.) Fr., *Epicr. syst. mycol.* (Upsaliae): 329 (1838) [1836-1838]; [28, 35, 38, 39, 44, 45, 54, 55] as *Gliophorus psittacinus*; [13, 26, 56, 57] as *Hygrocybe psittacina*; [9, 71] as *Hygrophorus psittacinus*; [71] as *Hygrophorus sciophanus*; citizen science observations – [https://bit.ly/2IJ5EqE; https://bit.ly/3njFABI; https://bit.ly/2W8HuJ9; https://bit.ly/3gJu2VV; https://bit.ly/3gUHSF3; https://bit.ly/380ZpHf; https://bit.ly/2W9GtKn; https://bit.ly/3oG3dVg; https://bit.ly/37gAmkC; https://bit.ly/2WcIZq0; https://bit.ly/2Wd4o24; https://bit.ly/3qSOyYD; https://bit.ly/2Lzazf1]; distribution – CF, KFS, LFS, LP, MCr, PF, RF, RFS, WFS, WUF.

**Gen. *Gloioxanthomyces* Lodge, Vizzini, Ercole & Boertm.**

20. *Gloioxanthomyces vitellinus* (Fr.) Lodge, Vizzini, Ercole & Boertm., in Lodge et al., *Fungal Diversity* **64**(1): 50 (2013) [2014] – *Gliophorus vitellinus* (Fr.) Kovalenko, *Mikol. Fitopatol.* **22**(3): 209 (1988); *Hygrocybe vitellina* (Fr.) P. Karst., *Bidr. Känn. Finl. Nat. Folk* **32**: 233 (1879); *Hygrophorus vitellinus* Fr., *Monogr. Hymenomyc. Suec.* (Upsaliae) **2**(2): 312 (1863) / [55] as *Gloioxanthomyces vitellinus*; [38] as *Gliophorus vitellinus*; [5] as *Hygrocybe vitellina*; [71] as *Hygrophorus vitellinus*; distribution – KFS, LGS, possibly LFGS, LGMS.

**Gen. *Haasiella* Kotl. & Pouzar**

21. *Haasiella venustissima* (Fr.) Kotl. & Pouzar ex Chiaffi & Surault, *Bull. trimest. Soc. mycol. Fr.* **112**: 127 (1996) / citizen science observations – [https://bit.ly/3812RBH; https://bit.ly/2W9KMMz]; distribution – RFS, RP; collections – CWU(MYC)8447.

**Gen. *Hygrocybe* (Fr.) P. Kumm.**

22. *Hygrocybe acutoconica* (Clem.) Singer, *Lilloa* **22**: 153 (1951) [1949] – *Hygrocybe langei* Kühner, *Botaniste* **18**: 174 (1927); *Hygrocybe persistens* (Britzelm.) Singer, *Revue Mycol.*, Paris **5**: 8 (1940) / [22] as *Hygrocybe langei*; [38] as *Hygrocybe persistens*; citizen science observations – [https://bit.ly/349INvU; https://bit.ly/3mjh6Ho; https://bit.ly/2We56fz; https://bit.ly/2LuYW8F; https://bit.ly/37ZB1WM; https://bit.ly/3oR64uB; https://bit.ly/34883Ti; https://bit.ly/3nk0roq; https://bit.ly/3qZ9BJk; https://bit.ly/2We5Z7T; https://bit.ly/37fGWaM; https://bit.ly/2WfZodi; https://bit.ly/3mko0fg; https://bit.ly/37gChoZ; https://bit.ly/3oR95uV; https://bit.ly/3nnMshi; https://bit.ly/380zgII; https://bit.ly/37hZ8kj; https://bit.ly/2Wh6OwG]; distribution – CF, KFS, LFS, RFS, possibly LGMS, RGMS; collections – CWU(MYC)8300, CWU(MYC)8327, CWU(MYC)8328, CWU(MYC)8330, CWU(MYC)8336, CWU(MYC)8339, CWU(MYC)8342, CWU(MYC)8343, CWU(MYC)8344, CWU(MYC)8345.
23. *Hygrocybe aurantiosplendens* R. Haller Aar., *Schweiz. Z. Pilzk.* **32**: 89 (1954) / [28]; distribution – CF.
24. *Hygrocybe cantharellus* (Schwein.) Murrill, *Mycologia* **3**(4): 196 (1911) – *Hygrophorus cantharellus* (Schwein.) Fr., *Epicr. syst. mycol.* (Upsaliae): 329 (1838) [1836-1838]; *Pseudohygrocybe cantharella* (Schwein.) Kovalenko [as '*cantharellus*'], *Mikol. Fitopatol.* **22**(3): 208 (1988) / [22, 28, 55] as *Hygrocybe cantharellus*; [71] as *Hygrophorus cantharellus*; [38] as *Pseudohygrocybe cantharella*; distribution – CF, KFS, LFS, LGMS; collections – CWU(MYC)8448.
25. *Hygrocybe ceracea* (Sowerby) P. Kumm., *Führ. Pilzk.* (Zerbst): 112 (1871) – *Hygrophorus ceraceus* (Wulfen) Fr., *Epicr. syst. mycol.* (Upsaliae): 330 (1838) [1836-

- 1838]; *Pseudohygrocybe ceracea* (Sowerby) Kovalenko, *Mikol. Fitopatol.* **22**(3): 208 (1988) / [39] as *Hygrocybe ceracea*; [9, 71] as *Hygrophorus ceraceus*; [38] as *Pseudohygrocybe ceracea*; distribution – LGS, RF, WUF.
26. *Hygrocybe chlorophana* (Fr.) Wünsche, *Die Pilze*: 112 (1877) – *Hygrophorus chlorophanus* (Fr.) Fr., *Epicr. syst. mycol.* (Upsaliae): 332 (1838) [1836-1838] / [28, 38, 45, 46, 57] as *Hygrocybe chlorophana*; [49, 71] as *Hygrophorus chlorophanus*; citizen science observations – [https://bit.ly/37exwfQ; https://bit.ly/2KrWlf7; https://bit.ly/2Wcc1Wv; https://bit.ly/2LveQzT]; distribution – CF, LFS, MCr, TR, WFS possibly FSCr.
27. *Hygrocybe coccinea* (Schaeff.) P. Kumm., *Führ. Pilzk.* (Zerbst): 112 (1871) – *Hygrophorus coccineus* (Schaeff.) Fr., *Epicr. syst. mycol.* (Upsaliae): 330 (1838) [1836-1838]; *Pseudohygrocybe coccinea* (Schaeff.) Kovalenko, *Mikol. Fitopatol.* **22**(3): 208 (1988) / [3, 21, 22, 43, 56, 57] as *Hygrocybe coccinea*; [71] as *Hygrophorus coccineus*; [38] as *Pseudohygrocybe coccinea*; citizen science observations – [https://bit.ly/2IJ5EqE; https://bit.ly/34cOI3p; https://bit.ly/3mjypYA; https://bit.ly/3njbiin]; distribution – CF, LFS, MCr, RP, SSCr, WUF.
28. *Hygrocybe coccineocrenata* (P.D. Orton) M.M. Moser, in Gams, *Kl. Krypt.-Fl.*, Edn 3 (Stuttgart) **2b/2**: 68 (1967) – *Hygrophorus coccineocrenatus* P.D. Orton, *Trans. Br. mycol. Soc.* **43**(2): 262 (1960); *Pseudohygrocybe coccineocrenata* (P.D. Orton) Kovalenko, *Mikol. Fitopatol.* **22**(3): 209 (1988) / [14, 15, 36, 55, 68] as *Hygrocybe coccineocrenata*; [71] as *Hygrophorus coccineocrenatus*; [38] as *Pseudohygrocybe coccineocrenata*; citizen science observations – [https://bit.ly/3abJo4g; https://bit.ly/3gJ3XWU; https://bit.ly/3oPtU9T; https://bit.ly/37jK5Gw; https://bit.ly/3oQgvOX; https://bit.ly/34fux50; https://bit.ly/3anzzjR; https://bit.ly/2Lq9nKH]; distribution – KFS, LFS, LP, RGS; collections – CWU(MYC)7850, CWU(MYC)8451, CWU(MYC)8452, CWU(MYC)8453, CWU(MYC)8454, CWU(MYC)8455.
29. *Hygrocybe conica* (Schaeff.) P. Kumm., *Führ. Pilzk.* (Zerbst): 111 (1871) – *Hygrocybe pseudoconica* J.E. Lange, *Dansk bot. Ark.* **4** (4): 24 (1923); *Hygrophorus conicus* (Schaeff.) Fr., *Epicr. syst. mycol.* (Upsaliae): 331 (1838) [1836-1838] / [3, 13, 15, 16, 22, 28, 38, 39, 43–45, 50, 55, 57, 58, 61, 64, 68] as *Hygrocybe conica*; [38] as *Hygrocybe pseudoconica*; [9, 11, 34, 49, 56, 71, 72] as *Hygrophorus conicus*; citizen science observations – [https://bit.ly/3gNdRa7; https://bit.ly/2K3ugLw; https://bit.ly/2KrWlf7; https://bit.ly/2WiimQc; https://bit.ly/3qQiyEF; https://bit.ly/2WbOSne; https://bit.ly/37jFIRo; https://bit.ly/34cujLS; https://bit.ly/37ePkHI; https://bit.ly/3qZGupg; https://bit.ly/34cAgZn; https://bit.ly/3mkh3er; https://bit.ly/37jG05n; https://bit.ly/2WeCDGv; https://bit.ly/2K346bL; https://bit.ly/2LAB7wq; https://bit.ly/3qTDgTX]; distribution – CF, KFS, LFS, LGMS, LP, MCr, PF, RF, RFS, RGMS, RP, SP, SSCr, TR, VFS, WFS, WUF, possibly RGS, LGS; collections – CWU(MYC)8337, CWU(MYC)8338, CWU(MYC)8450.
30. *Hygrocybe constrictospora* Arnolds, *Persoonia* **12**(4): 476 (1985) – *Pseudohygrocybe constrictospora* (Arnolds) Kovalenko, *Mikol. Fitopatol.* **22**(3): 208 (1988) / [28] as *Hygrocybe constrictospora*; [57] as *Pseudohygrocybe constrictospora*; citizen science observations – [https://bit.ly/2LyHO1Z]; distribution – CF; MCr.
31. *Hygrocybe helobia* (Arnolds) Bon, *Docums Mycol.* **6** (24): 43 (1976) / [26, 28]; distribution – CF.
32. *Hygrocybe insipida* (J.E. Lange) M.M. Moser, in Gams, *Kl. Krypt.-Fl.*, Edn 3 (Stuttgart) **2b/2**: 65 (1967) / [28]; citizen



- science observations – [\[https://bit.ly/2LyHO1Z\]](https://bit.ly/2LyHO1Z); distribution – CF, KFS, LFS, LGS, MCr, SSCr.
33. ***Hygrocybe miniata* (Fr.) P. Kumm., Führ. Pilzk. (Zerbst): 112 (1871) – *Hygrophorus miniatus* (Fr.) Fr., Epicr. syst. mycol. (Upsaliae): 330 (1838) [1836-1838]; *Pseudohygrocybe miniata* (Fr.) Kovalenko, Mikol. Fitopatol. **22**(3): 209 (1988); [15, 28, 45, 55, 63, 65, 68] as *Hygrocybe miniata*; [9, 11, 34, 71] as *Hygrophorus miniatus*; [38] as *Pseudohygrocybe miniata*; citizen science observations – [\[https://bit.ly/3nl7EV5\]](https://bit.ly/3nl7EV5); <https://bit.ly/382J310>; distribution – CF, KFS, LFS, LGMS, LP, RP.**
34. ***Hygrocybe mucronella* (Fr.) P. Karst., Bidr. Känn. Finl. Nat. Folk **32**: 235 (1879) – *Gliophorus reae* (Maire) Kovalenko, Mikol. Fitopatol. **22**(3): 209 (1988); *Hygrocybe reae* (Maire) J.E. Lange [as 'reai'], Dansk bot. Ark. **4**(4): 25 (1923) *Hygrophorus reae* Maire [as 'reai'], Trans. Br. mycol. Soc. **3**(3): 170 (1910) [1909] / [38] as *Gliophorus reae*; [5, 22, 64, 66, 68] as *Hygrocybe reae*; [71] as *Hygrophorus reae*; distribution – LFS, LGS, LGMS.**
35. ***Hygrocybe salicis-herbaceae* Kühner, Bull. trimest. Soc. mycol. Fr. **92**(4): 462 (1977) [1976] / [28]; distribution – CF.**
36. ***Hygrocybe splendidissima* (P.D. Orton) M.M. Moser, Die Röhrlinge und Blätterpilze (Agaricales): 67 (1967) / [28]; citizen science observations – [\[https://bit.ly/2LyHO1Z\]](https://bit.ly/2LyHO1Z); distribution – CF.**
37. ***Hygrocybe subpapillata* Kühner, Beih. Sydowia **8**: 248 (1979) / [28]; distribution – CF.**
38. ***Hygrocybe punicea* (Fr.) P. Kumm., Führ. Pilzk. (Zerbst): 112 (1871) – *Hygrophorus puniceus* (Fr.) Fr., Epicr. syst. mycol. (Upsaliae): 331 (1838) [1836-1838] / [5, 71] as *Hygrophorus puniceus*; citizen science observations – [\[https://bit.ly/2KmWQaC\]](https://bit.ly/2KmWQaC); distribution – CF, LFS.**
39. ***Hygrophorus agathosmus* (Fr.) Fr., Epicr. syst. mycol. (Upsaliae): 325 (1838) [1836-1838] / [13, 28, 38, 56, 57, 71]; citizen science observations – [\[http://bit.ly/2WoCArZ\]](http://bit.ly/2WoCArZ); <http://bit.ly/3nlVwmZ>; <http://bit.ly/37liqFm>; distribution – CF, KFS, LFS, LGS, MCr, SSCr.**
40. ***Hygrophorus arbustivus* Fr., Anteckn. Sver. Ätl. Svamp.: 46 (1836) / [54, 55]; distribution – KFS, possibly LFS; collections – CWU(MYC)7296, CWU(MYC)7298.**
41. ***Hygrophorus camarophyllus* (Alb. & Schwein.) Dumée, Grandjean & Maire, Bull. Soc. mycol. Fr. **28**: 292 (1912) / [28, 38, 45, 71]; distribution – CF.**
42. ***Hygrophorus chrysodon* (Batsch) Fr., Epicr. syst. mycol. (Upsaliae): 320 (1838) [1836-1838] / [3, 8, 13, 38, 46, 56, 57, 71, 72]; citizen science observations – [\[http://bit.ly/3mmArY3\]](http://bit.ly/3mmArY3); <http://bit.ly/3qXm7sx>; <http://bit.ly/3oOqX9E>; <http://bit.ly/3a93M5Y>; distribution – CF, LFS, MCr, RF, RFS, WFS, WUF, possibly PF, SP; collections – KW-M40619, KW-M40620, KW-M40621.**
43. ***Hygrophorus cossus* (Sowerby) Fr., Epicr. syst. mycol. (Upsaliae): 321 (1838) [1836-1838] / [13, 57, 70]; citizen science observations – [\[http://bit.ly/3mmArY3\]](http://bit.ly/3mmArY3); <http://bit.ly/3r2BWhy>; <http://bit.ly/37iBRyx>; <http://bit.ly/37o6r9Z>; distribution – KFS, MCr, SSCr, WFS.**
44. ***Hygrophorus discoxanthus* (Fr.) Rea, in Smith & Rea, Trans. Br. mycol. Soc. **3**(1): 45 (1908) [1907] / [28, 58]; distribution – CF.**
45. ***Hygrophorus eburneus* (Bull.) Fr., Epicr. syst. mycol. (Upsaliae): 321 (1838) [1836-1838] / [3, 9, 11, 13, 15, 16, 21, 28, 29, 38, 39, 41, 44, 46, 48, 54–59, 61, 70, 71]; citizen science observations – [\[http://bit.ly/3gPaiQB\]](http://bit.ly/3gPaiQB); <http://bit.ly/2WjQUBK>; <http://bit.ly/3npr0bH>; <http://bit.ly/3qVt2mh>; <http://bit.ly/3noMqFQ>; distribution – CF, KFS, LFS, LP, MCr, RF, RFS, RGS, RP, SSCr, TR, VFS, WUF, possibly LGMS, LGS, PF, RGMS, SP; collections – KW-M45302, KW-M45303, CWU(MYC)7623, CWU(MYC)7761.**
46. ***Hygrophorus erubescens* (Fr.) Fr., Epicr. syst. mycol. (Upsaliae): 322 (1838) [1836-1838] – *Hygrophorus capreolarius* (Kalchbr.) Sacc., Syll. fung. (Abellini) **5**: 391 (1887) / [21, 28, 38, 46, 49, 71] as *Hygrophorus erubescens*; [38, 71] as**

- Hygrophorus capreolarius*; distribution – CF, LFS, WUF.
47. ***Hygrophorus hiemalis* Velen., Novitates Mycologicae Novissimae: 15 (1947) / [28, 49]; possible distribution – CF.**
48. ***Hygrophorus hypothejus* (Fr.) Fr., Epicr. syst. mycol. (Upsaliae): 324 (1838) [1836-1838] / [3, 9, 13–16, 28, 38, 44, 46, 48, 52, 54–59, 61, 68, 70–72]; citizen science observations – [http://bit.ly/3gSnzrO; http://bit.ly/2K6Onsc; http://bit.ly/2LGnHPt; http://bit.ly/3mnq5HF; http://bit.ly/37m9oIh; http://bit.ly/3mh7Mni; http://bit.ly/2IR3N38; http://bit.ly/37meGDF; http://bit.ly/34jDqum; http://bit.ly/3agybiK; http://bit.ly/3aj1T6H; http://bit.ly/3mqciQm; http://bit.ly/2IW8BEy; http://bit.ly/37mkBZp; http://bit.ly/3gY02pm; http://bit.ly/3oOJT8e; http://bit.ly/3gS5DgP; http://bit.ly/3aeK2hp; http://bit.ly/2KxjrkW; http://bit.ly/3agr89B; http://bit.ly/3r1UEWE; http://bit.ly/34gCret; http://bit.ly/38b6ViO; http://bit.ly/3npiZU3; http://bit.ly/2Wiu6lV; http://bit.ly/2WvUYPH; http://bit.ly/34g7C9o; http://bit.ly/34iWkBk; http://bit.ly/3r3KgxU; http://bit.ly/2JZFdOl; http://bit.ly/38aRCXF; http://bit.ly/34fTYTL]; distribution – CF, DGMS, KFS, LFS, LGMS, LP, MCr, PF, RF, RFS, RGMS, RP, SGMS, SP, SSCr, TR, VFS, WFS, WUF; collections – CWU(MYC)7424, CWU(MYC)7435, CWU(MYC)7454, CWU(MYC)7481.**
49. ***Hygrophorus ligatus* (Fr.) Fr., Epicr. syst. mycol. (Upsaliae): 320 (1838) [1836-1838] – *Hygrophorus gliocyclus* Fr., Öfvers. K. Svensk. Vetensk.-Akad. Förhandl. 18(1): 27 (1861) / [7, 13, 38, 44, 56, 57, 71] as *Hygrophorus gliocyclus*; distribution – LFS, MCr.**
50. ***Hygrophorus limacinus* (Scop.) Fr., Epicr. syst. mycol. (Upsaliae): 324 (1838) [1836-1838] / [21]; distribution – LFS.**
51. ***Hygrophorus marzuolus* (Fr.) Bres., Atti Acad. Agiato Rovereto 2: 3 (1893) / [57, 71, 72]; distribution – MCr, possibly CF.**
52. ***Hygrophorus nemoreus* (Pers.) Fr., Epicr. syst. mycol. (Upsaliae): 326 (1838) [1836-1838] / [9, 13, 38, 39, 46, 48, 56, 57, 61, 70, 71]; citizen science observations – [http://bit.ly/2WmtSKK; http://bit.ly/34hzXMO]; distribution – CF, KFS, LFS, LGMS, MCr, RF, SSCr, WUF.**
53. ***Hygrophorus olivaceoalbus* (Fr.) Fr., Epicr. syst. mycol. (Upsaliae): 324 (1838) [1836-1838] / [3, 13, 21, 28, 30, 38, 45, 57, 68, 70, 71]; citizen science observations – [http://bit.ly/37lBl2U; http://bit.ly/385QvZm; http://bit.ly/34hYJwq; http://bit.ly/3mpuCcy; http://bit.ly/2WkwtES; http://bit.ly/34j2wcH]; distribution – CF, KFS, LFS, LGMS, LP, MCr, RFS, RP, SP, SSCr.**
54. ***Hygrophorus penarius* Fr., Anteckn. Sver. Ätl. Svamp.: 45 (1836) / [39, 57, 71]; citizen science observations – [http://bit.ly/3p1KJid; http://bit.ly/3qW8Gt3; http://bit.ly/3mmol11; http://bit.ly/3r4wURE]; distribution – CF, FSCr, LFS, MCr, RF, WFS, WUF.**
55. ***Hygrophorus persoonii* Arnolds, Persoonia 10(3): 365 (1979) / [28, 46]; citizen science observations – [http://bit.ly/386Qt3e; http://bit.ly/2Wmaf0; http://bit.ly/3oU4Oqw; http://bit.ly/2WxJBXv; http://bit.ly/3mmol11]; distribution – CF, KFS, LFS, RFS, WFS, WUF; collections – CWU(MYC)8060.**
56. ***Hygrophorus poetarum* R. Heim, Bull. trimest. Soc. mycol. Fr. 63: 127 (1948) [1947] / [57]; citizen science observations – [http://bit.ly/3mky741]; distribution – CF, FCr, MCr.**
57. ***Hygrophorus pudorinus* (Fr.) Fr., Anteckn. Sver. Ätl. Svamp.: 46 (1836) / [28, 45]; citizen science observations – [http://bit.ly/3mt4Gwp; http://bit.ly/3oVtVJr; http://bit.ly/3ahV2KY]; distribution – CF, PF, SP.**
58. ***Hygrophorus pustulatus* (Pers.) Fr., Epicr. syst. mycol. (Upsaliae): 325 (1838) [1836-1838] – *Hygrophorus tephroleucus* (Pers.) Fr., Epicr. syst. mycol. (Upsaliae): 325 (1838) [1836-1838] / [28, 30, 38, 46] as *Hygrophorus pustulatus*; [38, 71] as *Hygrophorus tephroleucus*; distribution – CF, WUF.**
59. ***Hygrophorus russula* (Schaeff. ex Fr.) Kauffman, Publications Mich. geol. biol. Surv., Biol. Ser. 5 26: 185 (1918) – *Agaricus russula* Schaeff. ex Fr., Syst. mycol. (Lundae) 1: 38 (1821) / [3, 4, 13, 28, 38, 41, 56–58, 67,**

72] as *Hygrophorus russula*; [9, 48] as *Agaricus russula*; distribution – CF, FSCr, LP, MCr, RF, RP, SSCr, WUF, possibly PF, SP.

60. *Hygrophorus unicolor* Gröger, Z. Mykol. 46(2): 160 (1980) – *Hygrophorus leucophaeus* (Scop.) Fr. *Epicr. syst. mycol.* (Upsaliae): 323 (1838) [1836-1838] / [13, 56, 70, 71] as *Hygrophorus leucophaeus*; distribution – FCr, MCr.

**Gen. *Lichenomphalia* Redhead, Lutzoni, Moncalvo & Vilgalys**

61. *Lichenomphalia hudsoniana* (H.S. Jenn.) Redhead, Lutzoni, Moncalvo & Vilgalys, *Mycotaxon* 83: 38 (2002) – *Omphalina hudsoniana* (H.S. Jenn.) H.E. Bigelow, *Mycologia* 62(1): 15 (1970) / [28, 33, 40] as *Lichenomphalia hudsoniana*; [3] as *Omphalina hudsoniana*; distribution – CF; TR.
62. *Lichenomphalia umbellifera* (L.) Redhead, Lutzoni, Moncalvo & Vilgalys, *Mycotaxon* 83: 38 (2002) – *Omphalina ericetorum* (Pers.) M. Lange, Meddr Grønland, Biosc. 147(11): 25 (1955); *Omphalia umbellifera* (L.) P. Kumm., *Führ. Pilzk. (Zerbst)*: 107 (1871) *Omphalina umbellifera* (L.) Quél., *Enchir. fung.* (Paris): 44 (1886) / [28, 39, 44, 45] as *Lichenomphalia umbellifera*; [14, 15, 36, 58, 71] as *Omphalina ericetorum*; [49] as *Omphalia umbellifera*; [21, 22] as *Omphalina umbellifera*; citizen science observations – [<https://bit.ly/37WWzTW>; <https://bit.ly/2JR3xBT>]; distribution – CF, LFS, LP, RF.
63. *Lichenomphalia velutina* (Quél.) Redhead, Lutzoni, Moncalvo & Vilgalys, *Mycotaxon* 83: 43 (2002) – *Omphalina grisella* (P. Karst.) M.M. Moser, in *Gams, Kl. Krypt.-Fl.*

*Mitteleuropa - Die Blätter- und Bauchpilze (Agaricales und Gastromycetes)* (Stuttgart) 2: 70 (1953); *Omphalina velutina* (Quél.) Quél., *Enchir. fung.* (Paris): 44 (1886) / [22, 64] as *Omphalina grisella*; [68] as *Omphalina velutina*; distribution – LFS, possibly KFS.

**Gen. *Neohygrocybe* Herink**

64. *Neohygrocybe nitrata* (Pers.) Herink, *Sb. severočesk. Mus., Hist. Nat.* 1: 71 (1958) – *Hygrocybe nitrata* (Pers.) Wünsche, *Die Pilze*: 112 (1877); *Hygrophorus nitratus* (Pers.) Fr., *Hymenomyc. eur.* (Upsaliae): 421 (1874) / [38] as *Neohygrocybe nitrata*; [22] as *Hygrocybe nitrata*; [9, 71] as *Hygrophorus nitratus*; distribution – LFS, LGMS, RF, WUF.
65. *Neohygrocybe ovina* (Bull.) Herink, *Sb. severočesk. Mus., Hist. Nat.* 1: 72 (1958) – *Hygrocybe ovina* (Bull.) Kühner, *Botaniste* 17(1-4): 43 (1926); *Hygrophorus ovinus* (Bull.) Fr., *Epicr. syst. mycol.* (Upsaliae): 328 (1838) [1836-1838] / [38] as *Neohygrocybe ovina*; [39] as *Hygrocybe ovina*; [9, 71]; distribution – RF, WUF.

**Gen. *Porpolomopsis* Bresinsky**

66. *Porpolomopsis calyptriformis* (Berk.) Bresinsky, *Regensb. Mykol. Schr.* 15: 145 (2008) – *Hygrocybe calyptriformis* (Berk.) Fayod, *Annls Sci. Nat., Bot., sér. 7* 9: 309 (1889); *Hygrophorus calyptriformis* (Berk.) Berk., *Outl. Brit. Fung.* (London): 202 (1860) / [5, 12, 22, 38, 68] as *Hygrocybe calyptriformis*; [71] as *Hygrophorus calyptriformis*; distribution – LFS, LGMS, possibly DGMS.

**DOUBTFUL FINDINGS**

1. *Arrhenia sphagnicola* (Berk.) Redhead, Lutzoni, Moncalvo & Vilgalys, *Mycotaxon* 83: 48 (2002); citizen science observations – [<https://bit.ly/3njHjqo>; <https://bit.ly/2JYQXAk>]; possible distribution – CF, TR; discussion – This species was determined “*in oculo nudo*”

from 2 citizen observations, so it can be confused with another *Arrhenia* species.

2. *Camarophyllus leporinus* (Pers.) Wünsche, *Die Pilze*: 116 (1877) / [22]; possible distribution – LFS; discussion – Possibly, this name was used *sensu Hygrophorus leporinus*, which is a synonym to *Hygrophorus nemoreus*.

3. ***Chromosera viola* (J. Geesink & Bas) Vizzini & Ercole**, *Micol. Veg. Medit.* **26**(1): 97 (2012) [2011]; citizen science observations – [https://bit.ly/3nfXaGD]; possible distribution – CF, TR; discussion – This name treated as doubtful because for now it is known only from one citizen science observation.
4. ***Cuphophyllus colemannianus* (A. Bloxam) Bon**, *Docums Mycol.* **14** (56): 10 (1985) [1984] – *Camarophyllus colemannianus* (A. Bloxam) Ricken, *Vadem. Pilzfr.* **2**: 197 (1920); *Hygrophorus colemannianus* A. Bloxam, *Ann. Mag. nat. Hist.*, Ser. 2 **13**: 403 (1854) / [22] as *Camarophyllus colemannianus*; [71] as *Hygrophorus colemannianus*; possible distribution – LFS, LGMS; discussion – Placed doubtful, because all few available sources of information about the distribution of this species in Ukraine seems to be not very exact, according to the fact that visually this species resembles *Cuphophyllus pratensis*, and, somehow, *Cuphophyllus fornicatus*.
5. ***Hygrocybe citrina* (Rea) J.E. Lange**, *Fl. Agaric. Danic.* **5**: 27 (1940) – *Gliophorus citrinus* (Rea) Kovalenko, *Opredelitel' Gribov SSSR* (Leningrad): 88 (1989); *Hygrophorus citrinus* Rea, *Trans. Br. mycol. Soc.* **3**(3): 228 (1910) [1909] / [63, 68, 71] as ***Hygrocybe citrina***; [38] as *Gliophorus citrinus*; [14] as *Hygrophorus citrinus*; possible distribution – LFS, LGMS, LGS, RFS, RGMS, RGS, SCr, WS; discussion – According to “Key to mushrooms of Ukraine” this species is synonymous to *Hygrophorus vitellinus*, which is synonymous to another valid species ***Gloioxanthomyces vitellinus*** [71]. Considering the fact that there were no recent recordings of ***Hygrocybe citrina*** in Ukraine, there is a possibility that some old records of ***Gloioxanthomyces vitellinus*** were published as ***Hygrocybe citrina***.
6. ***Hygrocybe flavescens* (Kauffman) Singer**, *Lloydia* **22**: 154 (1951) / [61]; possible distribution – RF, SP, WUF; discussion – This specimen is being known from the only record on the “UkrBIN” science project, where its photos strongly resemble ***Hygrocybe chlorophana***.
7. ***Hygrocybe intermedia* (Pass.) Fayod**, *Annls Sci. Nat., Bot., sér. 7* **9**: 309 (1889) / citizen science observations – [http://bit.ly/2KrWlf7]; possible distribution – CF; discussion – This species was determined “*in oculo nudo*” from the only citizen science observation, so can it be mistaken with other species from genus *Hygrocybe*.
8. ***Hygrocybe murinacea* (Bull.) M.M. Moser**, in Gams, *Kl. Krypt.-Fl.*, Edn 3 (Stuttgart) **2b/2**: 63 (1967) / [68]; possible distribution – LFS, LGMS, RFS, RGMS; discussion – This specimen is known only from one source with very approximate distribution data.
9. ***Hygrocybe nigrescens* (Quél.) Kühner**, *Botaniste* **17**(1-4): 57 (1926) / [22, 46, 64, 71]; possible distribution – CF, LP, RF RP, LFS, LGMS, WUF; discussion – According to “Key to mushrooms of Ukraine” this species is synonymous to another valid species ***Hygrocybe conica***, which also means that several records of ***Hygrocybe conica*** could be previously registered under this name [71]. Also, despite the presence of a recent recording of this species in “Agaricoid and boletoid fungi of the Galytskiy national nature reserve”, it's still better to consider it doubtful [46].
10. ***Hygrocybe spadicea* (Scop.) P. Karst.**, *Bidr. Känn. Finl. Nat. Folk* **32**: 237 (1879) – *Hygrophorus spadiceus* (Scop.) Fr., *Epicr. syst. mycol.* (Upsaliae): 332 (1838) [1836-1838] / [71] as *Hygrophorus spadiceus*; possible distribution – CF, MCr; discussion – This species is known only from one source without any distribution data, also there is told, that it can be present on mountain grasslands, so it may be a certain chance for this specimen to be found in Crimean mountains or Carpathians.
11. ***Hygrophorus hemorus*** / [21]; possible distribution – LFS; discussion – Probably a misspelling of ***Hygrophorus nemoreus***.
12. ***Hygrophorus latitabundus* Britzelm.**, *Botan. Zbl.* **80**: 118, pl. 437 (1899) / [38]; discussion – This species is being known only from one source without any distribution data.
13. ***Hygrophorus lindtneri* M.M. Moser**, *Z. Pilzk.* **33**: 3 (1967) – *Hygrophorus carpini* Gröger, *Z. Mykol.* **46**(2): 162 (1980) / [44, 57]

- as *Hygrophorus lindtneri*; [58] as *Hygrophorus carpini*; citizen science observations – [<http://bit.ly/34eXE8f>]; possible distribution – FCr, MCr, FCr, WUF; discussion – According to popular book “Fungi: familiar and unfamiliar. Manual-key to fungi species of Crimea”, this species is being synonymous with *Hygrophorus leucophaeus*, which is synonymous for valid species *Hygrophorus unicolor*, so there is a probability that some records of *Hygrophorus unicolor* were registered under name *Hygrophorus lindtneri* [57].
14. *Hygrophorus lucorum* Kalchbr., *Icon. Sel. Hymenomyc. Hung.* (Budapest): 35 (1874) / [71, 72]; possible distribution – CF; discussion – known only from two sources without any distribution data, however, it is told, that this specimen is usually present in larch forests, so there is a certain chance for it to be found in the Carpathians.
  15. *Hygrophorus mesotephrys* Berk. & Broome, *Ann. Mag. nat. Hist.*, Ser. 2 13: 402 (1854) / citizen science observations – [<http://bit.ly/2IW8BEy>]; possible distribution – RP; discussion – This species is being known only from the only citizen science observation, determined “*in oculo nudo*”, so can it be mistaken with other species from genus *Hygrophorus*.
  16. *Hygrophorus purpurascens* (Alb. & Schwein.) Fr., *Epicr. syst. mycol.* (Upsaliae): 322 (1838) [1836-1838] / [38, 71]; possible distribution – CF, MCr; discussion – This species is being known only from two sources without any distribution data, also, it is told, that this is a mountain species, so there is a certain probability for it to be found in Crimean mountains or Carpathians.
  17. *Hygrophorus queletii* Bres., *Fung. trident.* 1(1): 11 (1881) / [71]; possible distribution – CF; discussion – Known only from one source without any distribution data, it is told, that this specimen is usually present in larch forests, so there is a certain chance for it to be found in the Carpathians.
  18. *Melanomphalia nigrescens* M.P. Christ., *Friesia* 1(5): 289 (1936) / [71]; discussion – This specimen is known only from one source without any approximate distribution data, besides, visually *M. nigrescens* resembles some species of *Arrhenia* and *Omphalina* genera, so, can be mistaken.
  19. *Omphalina detrusa* (Fr.) Quél., *Enchir. fung.* (Paris): 42 (1886) / [21]; possible distribution – LFS; discussion – This name possibly could have been given to some species of *Arrhenia* or *Lichenomphalia*.
  20. *Omphalina gracillima* (Weinm.) Quél., *Enchir. fung.* (Paris): 46 (1886) / [21]; possible distribution – LFS; discussion – This name possibly could have been given to some species of *Arrhenia* or *Lichenomphalia*.
  21. *Omphalina grisea* (Fr.) Quél., *Enchir. fung.* (Paris): 45 (1886) / [21]; possible distribution – LFS; discussion – This name possibly could have been given to some species of *Arrhenia* or *Lichenomphalia*.
  22. *Omphalina pseudoandrosacea* (Bull.) M.M. Moser, in Gams, *Kl. Krypt.-Fl.*, Edn 3 (Stuttgart) 2b/2: 71 (1967) / [6]; possible distribution – KFS, LFS; discussion – Now a synonym of a valid Tricolomataceae species *Mycena pseudoandrosacea*. According to “Materials to mycoflora of the Central Russian Upland II” this species is a synonym to *Omphalina velutina*, which is a synonym to a valid specimen *Lichenomphalia velutina*, which means that it could be a *Lichenomphalia velutina* record, published as *Omphalina pseudoandrosacea* [6].

## DISCUSSION

Despite the considerable amount of Hygrophoraceae species, mentioned in the territory of Ukraine (66 names), we suppose that this list may be significantly updated within future researches.

Hygrophoraceae have both fleshy, watery basidiomata and thin-walled spores, therefore they require a steady humidity for the fructification [10, 42]. This is confirmed by the

known geographical patterns in distribution of the family: the hotspots of Hygrophoraceae diversity seem to be located in temperate regions with mild climate and no pronounced dry period, like British Isles or Russian Far East [10, 62].

Since Ukrainian climate gradually increases its continentality towards South-East [73], one might expect the highest Hygrophoraceae diversity in Ukraine within

Carpathians, Volyn and Polissya regions, with continuous decline towards the Steppe zone. However, that still is not the case based on current data (Fig. 1): most of observations were reported from the Carpathians and Left-Bank Forest-Steppe, followed by Western Ukrainian Forests, and Central Ukrainian macro-region. We suppose that this unexpected result is explained by the sampling bias and do not reflect any consistent biogeographical pattern.

The main sources of such a bias might be an overlooking of grassland habitats during a standard mycological field research, as well as the relatively rarity of Hygrophoraceae, which makes most observations (except for a few common species) rather casual and, therefore, complicates the field research of this group.

Another significant challenge in Hygrophoraceae research is a high value of the features of fresh fruit bodies, which mostly disappear in dried herbarium material. Therefore, even preserved specimens might be of little use, if they are not accompanied by high-quality photographs and detailed descriptions of fresh fruit bodies. The last circumstance, unfortunately, is not a case for the most of old Hygrophoraceae collections, making a critical revision rather complicate.

Consequently, the key things which might facilitate further Hygrophoraceae

studies in Ukraine are extensive surveys of grassland habitats, wider using of molecular identification methods, as well as implementation of the best practices in biodiversity data management, including photographing of fresh fruit bodies, digitization and databasing of observations.

## CONCLUSIONS

Herein we provide a comprehensive review of data on Hygrophoraceae in Ukraine, as a checklist. Sixty-six species from 13 genera were reported based on published papers, citizen science observations, and collection specimens.

Twenty-two names are treated as doubtful findings, with explanation in each case.

We provided an original description of the rare European species *Haasiella venustissima* (Fr.) Kotl. & Pouzar ex Chiaffi & Surault, which is reported for the first time from the territory of Ukraine.

In spite of the long history of investigations and huge amount of data, we suppose that the checklist might be significantly updated by the further extensive surveys of grassland habitats, by wider using of molecular identification methods, and by implementation of the best practices in biodiversity data management, including photographing of fresh fruit bodies, digitization and databasing of observations.

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УДК 582.284 (477)

## АНОТОВАНИЙ ПЕРЕЛІК ГІГРОФОРОВИХ ГРИБІВ (AGARICALES, BASIDIOMYCOTA) УКРАЇНИ

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Hygrophoraceae є родиною у складі порядку Agaricales, що включає 26 родів та близько 690 видів, серед яких ектомікоризні, ліхенотвірні, бріофільні гриби, гумусові та підстилкові сапротрофи. Деякі з-поміж них, наприклад, представники родів *Cyphophyllus*, *Hygrocybe*, *Neohygrocybe* та *Porpolomopsis*, тісно пов'язані з природними луками та є чутливими до наявності нітрогенвмісних добрив у ґрунті. Це робить їх індикаторними видами луків з високою природоохоронною цінністю.

Попри те, що окремі спостереження Гігрофорових траплялися в рамках ширших досліджень агарикоїдних грибів, вони ніколи не були об'єктом спеціального вивчення. Відтак наявні дані щодо Гігрофорових грибів України вимагають узагальнення та ревізії.

Ми підсумували наявні дані з траплянь Гігрофорових в Україні, включно з опублікованими працями, відритими базами даних, спостереженнями любителів, а також неопублікованими гербарними матеріалами. Також ми наводимо оригінальний опис рідкісного у Європі виду *Haasiella venustissima* (Fr.) Kotl. & Pouzar ex Chiaffi & Surault, що наводиться для України вперше.

Чеклист Гігрофорових України нараховує 66 видів. Провідними родами є *Hygrophorus* (22 види), *Hygrocybe* (17 видів) та *Arrhenia* (10 видів); 5 видів серед них, (*Hygrocybe punicea*, *Hyrgocybe splendidissima*, *Neohygrocybe nitrata*, *Neohygrocybe ovina*, *Porpolomopsis calyptriformis*), є загрожуваними та згідно з “ Червоним Списком IUCN” відносяться до категорії “Вразливі” (VU). Знахідки 22 видів розглядаються як сумнівні. Найбільше видів Гігрофорових було виявлено на території Карпатських Лісів та Лівобережного Лісостепу, що, ймовірно, більшою мірою зумовлене нерівномірною дослідженістю території України, аніж біогеографічними причинами. Попри тривалу історію досліджень та значний обсяг накопичених відомостей, ми очікуємо суттєві доповнення до чеклиста в майбутньому. Необхідними передумовами цього ми вважаємо цілеспрямовані обстеження трав’яних угруповань, ширше задіяння методів молекулярно-генетичної ідентифікації, а також впровадження сучасних стандартів роботи з даними про біорізноманіття, зокрема фотографування свіжих базидіюм, оцифровування спостережень та вивантаження їх до відкритих баз даних.

*Ключові слова:* агарикоїдні гриби, літературний огляд, громадська наука, *Haasiella venustissima*, перша реєстрація, Україна.

**Стаття надійшла 15. 09. 2020р.**

*Рекомендована до друку на засіданні редакційної колегії після рецензування*