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## FLORA, MYCOTA AND VEGETATION OF KUPENA RESERVE (RODOPI MOUNTAINS, BULGARIA)

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**Abstract.** The paper represents results from recent complex studies of flora, mycota and vegetation within the Kupena Reserve (Rodopi Mts, Bulgaria). Twenty six species, referred to 2 divisions, 4 classes and 17 families are recorded for the bryoflora. The vascular flora is presented by 370 species from 57 families, 122 of which are considered as medicinal plants. Eighty seven species of larger ascomycetes and basidiomycetes are found and reported for first time in the reserve. Four of them are of a high conservation value. The vegetation cover is consisted of mixed and monodominant deciduous and coniferous forests, as well as of mire, riverbank and mesic grasslands. Thirteen types of habitats according to the Habitats Directive classification have been recorded within the reserve.

**Key words:** bryophytes, conservation, habitats, larger fungi, medicinal plants, plant communities, species diversity, vascular plants.

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## INTRODUCTION

Kupena was designated as a strict reserve in 1961 with an area of 1761.1 ha and spread between 600 and 1400 m altitude. It is located in Western Rodopi Mts, northern parts of Batashka Mt and close to the town of Peshtera. The reserve is declared for protection of the natural landscape and wild flora and fauna and is listed (1977) in the UNESCO's Man and the Biosphere Programme (EXECUTIVE ENVIRONMENT AGENCY 2015). Almost entire territory of the reserve falls into the Special Area of Conservation BG0001030 "Rhodopes-Western" under the Habitats Directive.

Results from a study on the recent vegetation in the reserve are published by NIKOLOV & SIMENSKA (1985). The authors represent an overview of the variety of forest types determined by the altitude. The forest vegetation is characterized by the basic species composition of trees and shrubs and barely by the herbaceous species. A new species – *Carex lasiocarpa* Ehrh. (HAJEK ET AL. 2005) and a new mire association – *Caricetum nigrae* Braun 1915 (HAJEK ET AL. 2008) for the territory of Bulgaria were found within the reserve. A bigger achievement is the description of the new mire association *Geo coccinei-Sphagnetum contorti* Hajek et al. 2008 (HAJEK ET AL. 2008). Only one fungal species *Hypholoma udum* (Pers.: Fr.) Kühner has been reported from the reserve so far (GYOSHEVA & DIMITROVA 2011). This species, reported as *Psilocybe uda* (Pers.: Fr.) Gillet is included in the Red List of Bulgarian Fungi (GYOSHEVA ET AL. 2006) and in the Red Data Book of Republic of Bulgaria (GYOSHEVA 2015) under category *Endangered* (EN). The vegetation history of the reserve is revealed by the palynological studies of BOZILOVA ET AL. (1989), HUTTUNEN ET AL. (1992) and TONKOV ET AL. (2013, 2014).

As it is to be seen from the brief review above, Kupena Reserve has been insufficiently investigated. The paper represents results from a recent more complex scientific research in the reserve and thus sets a base for further detailed studies.

## MATERIAL AND METHODS

The study has been carried out during the vegetation season of 2014. The route method has been applied to describe the diversity of bryophytes, larger fungi, vascular plants and habitats. In the process of field studies the taxa found have been recorded in lists, and in case of difficulties to identify the species on the field samples were collected for laboratory work. Identification of taxa and nomenclature for vascular plants and bryophytes were according to the main taxonomic sources of Bulgaria (KOZHUHAROV 1992; DELIPAVLOV & CHESHMEDZHIEV 2003; JORDANOV 1963, 1964, 1966, 1970, 1973, 1976, 1979; VELCHEV 1982, 1989; KOZHUHAROV 1995; KOZHUHAROV & ANCHEV 2012; PETROV 1975). Author's name of fungal taxa are abbreviated according to KIRK & ANSELL (2004) and Index Fungorum. The list of medicinal plants followed Appendix 1 of Medicinal Plants Act. Special attention

has been paid to the taxa of a high conservation value. To evaluate the conservation status, the lists of established taxa were checked for endemics – Bulgarian and Balkan (PETROVA & VLADIMIROV 2010), protected species (Appendix 3 of Bulgarian Biological Diversity Act), rare and endangered species according to Bulgarian Red Lists and Red Data Books (PETROVA & VLADIMIROV 2009; PEEV ET AL. 2015), Red List of the Bryophytes in Bulgaria (NATCHEVA ET AL. 2006), Red List of Fungi in Bulgaria (GYOSHEVA ET AL. 2006), as well as European and international documents (e.g. Bern Convention, CITES). The syntaxonomy follows the methodological school of BRAUN-BLANQUET (1965). Habitats are defined according to the Habitats Directive (Council Directive 92/43/EEC).

## RESULTS AND DISCUSSION

### *Bryophytes*

Data on the distribution of bryophytes in Bulgaria show that 8% of the species found in Bulgaria so far (754 in total) have localities in Western Rodopi Mts. Bryophyte flora in the reserve comprises 26 species, referred to 2 divisions (liverworts and mosses), 4 classes and 17 families and occupies various substrata as decaying wood, rocks, bare soil, mire areas (*Appendix 1*). Bryophyte species composition is typical for well preserved forest habitats, which are not affected by human impact. One conservationally important bryophyte was found – *Calliargon giganteum* (Schimp.) Kindb. (**Table 1**), a species listed as Endangered (EN) in the Red List of Bryophytes in Bulgaria (NATCHEVA ET AL. 2006) and in the Red Data Book of Plants and Fungi of the Republic of Bulgaria (PEEV ET AL. 2015). The species is hygrophyte growing in mires. It was found together with *Sphagnum subsecundum* Nees and *Aulacomnium palustre* in a habitat 91D0 Bog woodlands, which is of priority importance and listed in the Habitats Directive

### *Vascular flora*

A total of 370 taxa of vascular plants has been found (*Appendix 1*). To Equisetophyta belong two species, ferns (Polypodiophyta) are represented by seven species, five species are conifers (Pinophyta) and others (354 taxa) are flowering plants (Magnoliophyta), including 98 monocots and 258 dicots. Plant diversity is spread within 59 plant families. The most species rich families are Poaceae (41 species), Asteraceae (30 species), Fabaceae (27 species), Rosaceae (24 species), and Lamiaceae and Cyperaceae (each with 20 species). Within the established families with the greatest number of genera is Poaceae (23) followed by Asteraceae (19), Lamiaceae (14) and Rosaceae (13). The most species-rich genera are *Carex* (16 taxa), *Ranunculus*, *Galium* and *Juncus* – each with 8 species, *Poa* (7 taxa), *Trifolium* and *Lathyrus* – each with 6 species and *Potentilla*, *Geranium* and *Myosotis* – each with 5 species.

**Table 1.** Species of conservation significance. Abbreviations used: Bal – Balkan, CITES – Convention on International Trade in Endangered Species of Wild Fauna and Flora, EN – *Endangered*, NT – *Near Threatened*, VU – *Vulnerable*; BBDA – Bulgarian Biological Biodiversity Act.

Species	BBDA	Bern	CITES	Endemics	Red Books of Bulgaria	Red lists of Bulgaria
<b>Bryophytes</b>						
<i>Calliergon giganteum</i> (Schimp.) Kindb.					EN	EN
<b>Vascular flora</b>						
<i>Achillea clypeolata</i> Sm.				Bal		
<i>Carex elata</i> All.					EN	EN
<i>Carex limosa</i> L.					EN	EN
<i>Cirsium appendiculatum</i> Griseb.				Bal		
<i>Digitalis viridiflora</i> Lindl.				Bal		
<i>Fritillaria gussichiae</i> (Degen et Doerfl.) Rix	+	+		Bal		NT
<i>Geum rhodopaeum</i> Stoj. et Stef.	+			Bal		NT
<i>Lathraea rhodopea</i> Dingler	+			Bal		NT
<i>Orchidaceae</i> spp. (see <i>App. 1</i> )			+			
<i>Pastinaca hirsuta</i> Pančić				Bal		
<i>Potentilla palustris</i> (L.) Scop.	+					VU
<i>Pyrola media</i> Sw.						VU
<b>Larger fungi</b>						
<i>Auriscalpium vulgare</i> Gray					EN	EN
<i>Bondarzewia montana</i> (Quél.) Singer					EN	EN
<i>Lentaria byssiseda</i> Corner						VU
<i>Spathularia flavida</i> Pers.: Fr.						NT

### **Medicinal plants**

Among the recorded vascular plants 122 species are considered as medicinal plants. The richest families are Rosaceae (13 species), Lamiaceae (10 species) and Asteraceae (9 species). The region of Snezhanka cave has the greatest number of medicinal plants. Most of the medicinal plants found on the territory of Kupena reserve have limited distribution (only one locality) and low population density. According to the possibilities for collection from nature, medicinal plants of the reserve should be grouped as follows:

I – species forbidden for collection from nature for commercial purposes but with allowed collection for personal purposes according to Order RD–83/3.02.2014 of the Minister of Environment and Waters: 3 species – *Asplenium trichomanes* L., *Orchis* sp. div., *Valeriana officinalis* L.;

II – species with limited permission for collection from nature for commercial purposes with annually defined regions and quantities, according to Order RD–83/3.02.2014 of the Minister of Environment and Waters: 3 species – *Alchemilla vulgaris* complex, *Galium odoratum* (L.) Scop., *Primula veris* L.;

III – species object of preservation and regulated use from nature according to appendix 4 of Biodiversity Act: 4 species – *Dryopteris filix-mas* (L.) Schott., *Lilium martagon* L., *Orchis pallens* L., *Salix caprea* L.;

IV – wide distributed medicinal plants: 115 species. In this category as common species with abundant populations for the territory of Kupena reserve should be mentioned *Cardamine bulbifera* (L.) Crantz and *Euphorbia amygdaloides* L. as well as the dominants in coniferous forests like *Pinus sylvestris* L. and *Picea abies* (L.) Karst.

### **Larger fungi**

The checklist of larger fungi found during the field studies in the reserve includes 87 species – 7 from Ascomycota and 80 from Basidiomycota. The species belong to 6 classes, 12 orders, 38 families and 57 genera and all of them are new records for Kupena Reserve. Four species are of a high conservation value, included in the Red List of Fungi in Bulgaria under different threat categories: *Auriscalpium vulgare* Gray – Endangered (EN), *Bondarzewia montana* (Qué.) Singer – Endangered (EN), *Lentaria byssiseda* Corner – Vulnerable (VU) and *Spathularia flavida* Pers.: Fr. – Near Threatened (NT) (**Fig. 1**). Two species of them (*Auriscalpium vulgare* and *Bondarzewia montana*) are included also in the Red Data Book of Plants and Fungi of the Republic of Bulgaria (PEEV ET AL. 2015). Prevailing number of larger fungi was registered in forest habitats – coniferous and beech woods. The mixed woods (*Picea abies*, *Pinus sylvestris*, *Abies alba* Mill. and *Fagus sylvatica* L.) were exceptionally rich of fungal species.



**Fig. 1.** *Spathularia flavida* Pers.: Fr. – Near Threatened (NT) species in the Red List of fungi in Bulgaria.

### **Vegetation and habitats**

The reserve territory is large, comprising diverse landscape and as a reflection of this the vegetation is also very diverse. This territory preserves most kinds of the Rodopi wild nature. The forests prevail and their distribution is determined by altitudinal climatic belts. At the foothills oak forests dominate. They are most

species rich due to the open structure and thermophilic conditions. Mixed forests of *Carpinus betulus* L. and *Quercus daleschampii* Ten. are developed at the lower altitudes. In the tree layer *Acer campestre* L., *Fraxinus ornus* L. and *Tilia cordata* Mill. could be also found. *Festuca heterophylla* Lam., *Cardamine bulbifera* (L.) Crantz and *Melica uniflora* Retz. dominate within the aboveground layer. The beech forests occupy the higher elevation. They could be observed at different exposures, but are characterized by poorer biodiversity as compared to the oak forests. Regarding the soil reaction the beech forests are split to three categories on neutrophil, acidophil and carbonate terrains. The neutrophil forests belong to the widespread Asperulo-Fagetum association. Despite of some species specific to the Rodopi Mts, this association is typical example of Central European vegetation type. In the aboveground layer *Sanicula europaea* L., *Cardamine bulbifera*, *Lamiastrum galeobdolon* (L.) Ehrend. et Polatchek and *Melica uniflora* could be found very often. Another type of beech forests is represented by Luzulo-Fagetum association. It is the most species poor and *Luzula luzuloides* (Lam.) Dandy takes the dominant position in the aboveground level. On carbonate terrains communities of Cephalanthero-Fagion are developed. *Pinus nigra* subsp. *pallasiana* (Lamb.) Holmb. takes place rarely in these forests. A peculiarity of Cephalanthero-Fagion forests is the presence of different orchids like *Cephalanthera rubra* (L.) L. C. M. Richard, *Epipactis* spp. and *Neottia nidus-avis* (L.) Rich. Upwards the slopes the beech forests become mixed with *Abies alba*, *Pinus sylvestris* and *Picea abies*. The coniferous forests become the prevailing type on the highest mountain parts. Scots pine and spruce communities prevail, while *Abies alba* is present by single individuals. Syntaxonomically these communities are included in Vaccinio-Piceetea class. In the Rodopi Mts they are characterized by three strata – tree, herbaceous and moss. The herbaceous stratum most frequently includes *Vaccinium myrtillus* L., *Vaccinium vitis-idaea* L., *Luzula sylvatica* (Hudson) Gandin and *Calamagrostis arundinacea* (L.) Roth. The moss layer is species rich and usually has high cover. Common species are *Dicranum scoparium* Hedw., *Hylocomium splendens* (Hedw.) Schimp., *Hypnum cupressiforme* Hedw. and *Eurhynchium angustirette* (Broth.) T. J. Kop. In the reserve territory coniferous forests occupy deep Cambisols with acidic reaction as a result of dissolved humic substances generated by slow decomposition process of pine needles. In Kupena reserve *Picea abies* forests belong to the climax vegetation. Mixed spruce and Scots pine forests are quite similar to the monodominant spruce stands despite that are developed mostly on slopes with southern exposure. We observed high density of young spruce individuals in these mixed forests which is an indication of ongoing successional process toward monodominant *Picea abies* woods.

In the forest openings we found grasslands dominated by *Festuca nigrescens* Lam. These communities are species rich and syntaxonomically are related to Molinio-Arrhenatheretea class. Forest fringes include grassland communities related to Trifolio-Geranietea class and Trifolion medii alliance.

Special attention deserve the wetland communities of Scheuchzerio-Caricetea nigrae class. These communities are very unique for the reserve territory. They are developed on plane areas or slight depressions covered all year by water table. The species diversity comprises *Carex elata* All., *Carex lasiocarpa* Ehrh., *Carex curta* Good, *Juncus effusus* L., *Potentilla palustris* (L.) Scop. A famous peatland with Caricetum nigrae association exists in the Kupena reserve. Close vicinity is occupied by Geo coccinei-Sphagnetum contorti association (see HAJEK ET AL. 2008). It is surrounded by coniferous forests which are a very good example of NATURA 2000 habitat 91D0 \*Bog woodland. The peatland area has relict origin which is proved by fossil records of *Isoetes* L. by LAZAROVA ET AL. (2011).

Small rivers and brooks cross the reserve territory and their banks are covered by tall herb communities of Mulgedio-Aconitetea class. These communities are distinct and include Balkan endemics such as *Cirsium appendiculatum* Griseb.

Following the Directive 92/43 EEC for habitats, the reserve includes 3260 Water courses of plain to montane levels with Ranunculion fluitantis and Callitricho-Batrachion vegetation, 6430 Hydrophyllous tall herb fringe communities of plants and of mountain to alpine level, 7140 Transition mires and quaking bogs, 8210 Calcareous rocky slopes with chasmophytic vegetation, 8220 Siliceous rocky slopes with chasmophytic vegetation, 9110 Luzulo-Fagetum beech forests, 9130 Asperulo-Fagetum beech forests, 9150 Medio-European limestone beech forests of the Cephalanthero-Fagion, 91BA Moesian silver fir forests, 91CA Rhodopide and Balkan Range Scots pine forests, 91D0 \*Bog woodland, 9170 Galio-Carpinetum oak-hornbeam forests, 9410 Acidophilous *Picea* forests of the montane to alpine levels (Vaccinio-Piceetea).

***Syntaxonomical synopsis of identified communities:***

- Cl. Vaccinio-Piceetea Br.-Bl. in Br.-Bl. et al. 1939
  - All. Piceion abietis Pawłowski et al. 1928
    - Ass. Vaccinio myrtilli-Piceetum abietis Šoltés 1976
  - All. Dicrano-Pinion (Libbert 1933) Matuszkiewicz 1962
    - Ass. Vaccinio myrtilli-Pinetum sylvestris Juraszek 1928
- Cl. Carpino-Fagetea Jakucs ex Passarge 1968
  - All. Carpinion betuli Issler 1931
    - All. Fagion sylvaticae Luquet 1926
      - Ass. Galio odorati-Fagetum sylvaticae Sougnez et Thill 1959
    - All. Cephalanthero-Fagion Tüxen 1955
      - All. Luzulo-Fagion sylvaticae Lohmeyer et Tüxen in Tüxen 1954
        - Ass. Luzulo luzuloidis-Fagetum sylvaticae Meusel 1937
      - All. Tilio platyphylli-Acerion Klika 1955
  - Cl. Scheuchzerio-Caricetea nigrae Tuxen 1937
    - All. Sphagno-Caricion canescentis Passarge (1964) 1978
      - Ass. Caricetum nigrae Braun 1915

- All. Sphagno warnstorffii-Tomenthypnion nitentis Dahl 1956  
 Ass. Geo coccinei-Sphagnetum contorti Hajek et al. 2008  
 Cl. Trifolio-Geranietea sanguinei Müller 1961  
 All. Trifolion medii Müller 1962  
 Cl. Mulgedio-Aconitetea Hadač et Klika in Klika et Hadač 1944  
 All. Cirsion appendiculati Horvat et al. 1937

*Appendix 1.* List of taxa recorded in the Kupena Reserve.

**BRYOPHYTES**

**Marchantiophyta (Liverworts)**

**Jungermanniopsida**

Geocalycaceae: *Chiloscyphus polyanthus* (L.) Corda

**Bryophyta (Mosses)**

**Sphagnopsida (Peat mosses)**

Sphagnaceae: *Sphagnum subsecundum* Nees

**Polytrichopsida**

Polytrichaceae: *Atrichum undulatum* (Hedw.) P. Beauv.; *Polytrichum commune*

Hedw.

**Bryopsida**

**Grimmiaceae:** *Grimmia trichophylla* Grev.; *Racomitrium canescens* (Hedw.)

Brid.; *R. sudeticum* (Funck) Bruch et Schimp.

**Dicranaceae:** *Dicranum scoparium* Hedw.; *Dicranum tauricum* Sapjegin

**Ditrichaceae:** *Ceratodon purpureus* (Hedw.) Brid.

**Hedwigiaceae:** *Hedwigia ciliata* (Hedw.) P. Beauv.

**Aulacomniaceae:** *Aulacomnium palustre* (Hedw.) Schwägr.

**Bartramiaceae:** *Bartramia pomiformis* Hedw.

**Bryaceae:** *Bryum alpinum* With.; *B. caespiticium* Hedw.

**Mniaceae:** *Mnium stellare* Hedw.

**Campyliaceae:** *Sanionia uncinata* (Hedw.) Loeske; *Calliergon giganteum* (Schimp.) Kindb.

**Brachytheciaceae:** *Brachytheciastrum velutinum* (Hedw.) Ignatov et Huttunen; *Homalothecium lutescens* (Hedw.) H. Rob.; *Cirriphyllum crassinervium* (Taylor) Loeske et M. Fleisch.; *Eurhynchium angustirete* (Broth.) T. J. Kop.

**Climaciaceae:** *Climacium dendroides* (Hedw.) F. Weber et D. Mohr

**Hypnaceae:** *Hypnum cupressiforme* Hedw.

**Hylocomiaceae:** *Hylocomium splendens* (Hedw.) Schimp.

**Leucodontaceae:** *Leucodon sciuroides* (Hedw.) Schwägr.

**VASCULAR PLANTS** [medicinal plants are marked by asterix (\*):

**Equisetophyta**

**Equisetaceae:** \**Equisetum arvense* L.; \**E. palustre* L.



## **Polypodiophyta**

**Athyriaceae:** \**Athyrium filix-femina* (L.) Roth;

**Aspidiaceae:** \**Dryopteris filix-mas* (L.) Schott.

**Aspleniaceae:** *Asplenium adiantum-nigrum* L.; *A. onopteris* L.; \**A. trichomanes* L.

**Hypolepidaceae:** \**Pteridium aquilinum* (L.) Kuhn;

**Polypodiaceae:** \**Polypodium vulgare* L.

## **Pinophyta**

**Cupressaceae:** *Juniperus communis* L.

**Pinaceae:** \**Abies alba* Mill.; \**Picea abies* (L.) Karst.; \**Pinus sylvestris* L.; *P. nigra* subsp. *pallasiana* (Lamb.) Holmb.

## **Magnoliophyta**

### **Magnoliopsida**

**Aceraceae:** *Acer campestre* L.; \**A. platanoides* L.; *A. pseudoplatanus* L.

**Anacardiaceae:** *Cottinus coggygria* L.

**Apiaceae:** *Aegopodium podagraria* L.; \**Angelica sylvestris* L.; *Anthriscus sylvestris* (L.) Hoffm.; *Heracleum ternatum* Velen.; *Laser trilobium* (L.) Borkh.; *Oenanthe silaifolia* Bieb.; *O. stenoloba* Schur; *Pastinaca hirsuta* Pančić; *Physospermum cornubiense* (L.) DC.; \**Sanicula europaea* L.

**Araliaceae:** \**Hedera helix* L.

**Asteraceae:** *Achillea grandifolia* Friv.; \**A. millefolium* L.; *A. clypeolata* Sibth. et Sm.; \**Anthemis tinctoria* L.; *Arctium lappa* L.; \**Artemisia vulgaris* L.; \**Bellis perennis* L.; *Centaurea cuneifolia* Sirth. et Sm.; *C. phrygia* L.; *C. stoebe* L.; \**Cichorium intybus* L.; *Cirsium appendiculatum* Griseb.; *C. arvense* (L.) Scop.; *C. creticum* (Lam.) D'Urv.; *C. ligulare* Boiss.; *Hieracium murorum* Gr.; *H. umbellatum* L.; *Inula conyza* DC.; *Leontodon autumnalis* L.; *L. hispidus* L.; \**Leucanthemum vulgare* Lam.; *Mycelis muralis* (L.) Dumort.; \**Solidago virgaurea* L.; *Petasites hybridus* (L.) P. Gaertner, B. Meyer et Schreb.; *Prenanthes purpurea* L.; *Tanacetum corymbosum* (L.) Schultz-Bip.; *T. vulgare* L.; *Taraxacum* sect. *Ruderalia*; \**Tussilago farfara* L.

**Betulaceae:** *Alnus glutinosa* (L.) Gaertner; *Betula pendula* Roth; \**Carpinus betulus* L.; *C. orientalis* Mill.; \**Corylus avellana* L.; *Ostrya carpinifolia* Scop.

**Boraginaceae:** *Cynoglossum hungaricum* Simon.; *Myosotis arvensis* (L.) Hill; *M. ramosissima* Rochel; *M. scorpioides* L.; *M. sicula* Guss.; *M. sylvatica* Ehrh. ex Hoffm.; \**Pulmonaria officinalis* L.; *P. rubra* Schott; \**Symphytum officinale* L.; *S. tuberosum* L.

**Brassicaceae:** \**Alliaria petiolata* (M. Bieb.) Cavara et Grande; *Alyssum murale* Waldst. et Kit.; *Arabis hirsuta* (L.) Scop.; *A. proccurens* Waldst. et Kit.; \**Cardamine bulbifera* (L.) Crantz; *Erysimum cuspidatum* (Bieb.) DC; *Rorippa sylvestris* (L.) Besser.

**Campanulaceae:** *Campanula glomerata* L.; *C. patula* L.; \**C. persicifolia* L.; *C. rapunculoides* L.

**Caprifoliaceae:** *Lonicera nigra* L.; \**Sambucus nigra* L.; *Sambucus racemosa* L.; \**Viburnum opulus* L.

**Caryophyllaceae:** *Dianthus deltoides* L.; *D. cruentus* Griseb.; \**Lychnis coronaria* (L.) Desr.; \**Lychnis flos-cuculi* L.; *Minuartia caespitosa* (Ehrh.) Deg.; *Scleranthus annuus* L.; *Silene armeria* L.; *S. roemerii* Friv.; *S. viridiflora* L.; *S. vulgaris* (Moench) Garcke; \**Stellaria graminea* L.; *S. holostea* L.; \**S. media* (L.) Vill.; *S. nemorum* L.; \**Viscaria vulgaris* Röhl.

**Celastraceae:** *Euonymus europaeus* L.; *E. latifolius* (L.) Mill.

**Cistaceae:** *Helianthemum nummularium* (L.) Miller.

**Cornaceae:** \**Cornus mas* L.

**Crassulaceae:** *Sedum cepaea* L.; *S. pallidum* M. Bieb.

**Dipsacaceae:** *Dipsacus laciniatus* L.; \**Knautia arvensis* (L.) Coult.; *K. drymeia* Heuff.

**Ericaceae:** \**Vaccinium myrtilloides* L., \**V. vitis-idaea* L.

**Euphorbiaceae:** \**Euphorbia amygdaloides* L.; \**E. cyparissias* L.; \**Mercurialis perennis* L.

**Fabaceae:** *Astragalus glycyphyllos* L.; *Chamaecytisus hirsutus* (L.) Link; *C. supinus* (L.) Link; \**Coronilla varia* L.; *Dorycnium herbaceum* Vill.; *Galega officinalis* L.; *Genista carinalis* Griseb.; *G. depressa* Bieb.; *G. lydia* Boiss.; *Lathyrus latifolius* L.; *L. laxiflorus* (Desf.) O. Kuntze; *L. niger* (L.) Bernh.; *L. pratensis* L.; *L. venetus* (Mill.) Wohlf.; \**L. vernus* (L.) Bernh.; *Lotus corniculatus* L.; *Medicago lupulina* L.; *Melilotus alba* Med.; \**Trifolium alpestre* L.; *T. campestre* Schreber; *T. fragiferum* subsp. *bonannii* (C. Presl) Soják; *T. medium* L.; \**T. pratense* L.; \**T. repens* L.; *Vicia incana* Gouan.; *V. sepium* L.; *V. tetrasperma* (L.) Schreber.

**Fagaceae:** \**Fagus sylvatica* L.; *Quercus dalechampii* Ten.; *Q. pubescens* Willd.

**Geraniaceae:** *Geranium columbinum* L.; \**G. macrorrhizum* L.; *G. phaeum* L.; \**G. robertianum* L.; *G. sanguineum* L.

**Hypericaceae:** \**Hypericum cerastoides* (Spach) N. K. B. Robson; \**H. maculatum* Crantz; *H. olympicum* L.; \**H. perforatum* L.

**Lamiaceae:** *Ajuga genevensis* L.; \**A. laxmanii* (L.) Benth.; *A. reptans* L.; *Calamintha nepeta* (L.) Savi; \**Clinopodium vulgare* L.; *Lamium galeobdolon* (L.) Ehrend. & Polatschek; *Lamium garganicum* L.; \**L. purpureum* L.; *Lycopus exaltatus* L.; \**Mentha longifolia* (L.) Hudson; \**M. spicata* L.; *Nepeta nuda* L.; \**Origanum vulgare* L.; \**Prunella vulgaris* L.; \**Salvia glutinosa* L.; *Scutellaria columnae* All.; *S. velenovskyi* Reich. f.; *Stachys germanica* L.; \**S. sylvatica* L.; \**Teucrium chamaedrys* L.

**Lythraceae:** *Lythrum salicaria* L.

**Oleaceae:** \**Fraxinus ornus* L.; *Jasminum fruticans* L.; *Ligustrum vulgare* L.; *Syringa vulgaris* L.

**Onagraceae:** *Circaea lutetiana* L.; *Epilobium angustifolium* L.; *E. collinum* C. C. Gmel.; *E. montanum* L.; *E. palustre* L.

**Oxalidaceae:** \**Oxalis acetosella* L.

**Plantaginaceae:** \**Plantago lanceolata* L.; \**P. major* L.; \**P. media* L.

**Polygalaceae:** \**Polygala vulgaris* L.

**Polygonaceae:** \**Rumex acetosa* L.; \**R. acetosella* L.; *R. conglomeratus* Murray.

**Primulaceae:** \**Lysimachia nummularia* L.; *L. vulgaris* L.; \**Primula veris* L.

**Pyrolaceae:** \**Orthilia secunda* (L.) House; *Pyrola media* Swartz; *P. minor* L.

**Ranunculaceae:** \**Actaea spicata* L.; \**Clematis vitalba* L.; *Ranunculus acris* L.; *R. auricomus* L.; \**R. flammula* L.; *R. ficaria* L.; *R. millefoliatus* Vahl; *R. montanus* Willd.; \**R. polyanthemus* L.; \**R. repens* L.

**Rosaceae:** \**Agrimonia eupatoria* L.; *Aremonia agrimonoides* (L.) DC.; \**Alchemilla flabellata* Busser; *A. gracilis* Opiz.; *A. vulgaris* agg.; *Cotoneaster integerrimus* Medicus; \**Crataegus monogyna* Jacq.; \**Filipendula ulmaria* (L.) Maxim.; \**F. vulgaris* Moenh.; \**Fragaria vesca* L.; *F. viridis* Duchesne; *Geum rhodopaeum* Stoj. et Stef.; \**G. urbanum* L.; \**Potentilla argentea* L.; \**P. erecta* (L.) Raeusch.; *P. micrantha* Ramond. ex DC.; \**P. palustris* (L.) Scop.; \**P. reptans* L.; *Prunus avium* L.; *Rosa canina* L.; *R. tomentosa* Sm.; \**Rubus hirtus* Walds. & Kit.; \**Sorbus aucuparia* L.; *S. torminalis* (L.) Crantz.

**Rubiaceae:** *Cruciata glabra* (L.) Ehrend.; \**C. laevipes* Opiz; *Galium aparinae* L.; \**G. lucidum* All.; \**G. odoratum* (L.) Scop.; *G. palustre* L.; *G. pseudoristatum* Schur.; *G. rivale* (Sibth. & Sm.) Griseb.; *G. rotundifolium* L.; \**G. verum* L.

**Salicaceae:** \**Populus tremula* L.; \**Salix caprea* L.

**Saxifragaceae:** *Saxifraga tridactylites* L.

**Scrophulariaceae:** *Digitalis viridiflora* Lindl.; *Lathraea rhodopea* Dingler; *Linaria vulgaris* Miller; *Rhinanthus rumelicus* Velen.; *Verbascum glabratum* Friv.; *V. longifolium* Ten.; \**Veronica chamaedrys* L.; *V. montana* L.; *V. serpilifolia* L.; *V. urticifolia* Jacq.

**Solanaceae:** *Physalis alkekengii* L.

**Tiliaceae:** \**Tilia cordata* Mill.; \**T. platyphyllos* Scop.; \**T. tomentosa* Moench.

**Ulmaceae:** *Ulmus minor* Miller.

**Urticaceae:** \**Urtica dioica* L.

**Valerianaceae:** \**Valeriana officinalis* L.

**Verbenaceae:** \**Verbena officinalis* L.

**Violaceae:** *Viola canina* L.; \**V. hirta* L.; \**V. odorata* L.; *V. riviniana* Reichb.; \**V. tricolor* L.

## Liliopsida

**Cyperaceae:** *Carex canescens* L.; *C. caryophylla* Latourr.; *C. cuprina* (Heuff.) A. Kern.; *C. curta* Good.; *C. echinata* Murray; *C. elata* All.; *C. flava* L.; *C. hirta* L.;

*C. humilis* Leyss.; *C. lasiocarpa* Ehrh.; *C. laevigata* Sm.; *C. limosa* L.; *C. ovalis* Good.; *C. pallescens* L.; *C. rostrata* Stokes; *C. vesicaria* L.; *Eleocharis palustris* (L.) Roemer & Schultes; *E. uniglumis* (Link) Schultes; \**Eriophorum angustifolium* Honckeny; \**E. latifolium* Hoppe; *Scirpus sylvaticus* L.

**Dioscoreaceae:** *Tamus communis* L.

**Juncaceae:** *Juncus articulatus* L.; *J. atratus* Krocke; *J. compressus* Jacq.; *J. conglomeratus* L.; *J. effusus* L.; *J. filiformis* L.; \**J. inflexus* L.; *J. thomasi* Ten.; *Luzula forsteri* (Sm.) DC.; *L. luzuloides* (Lam.) Dandy; *L. multiflora* (Retz.) Lej.; *L. sudetica* (Willd.) DC.; *L. sylvatica* (Hudson) Gaudin.

**Liliaceae:** \**Colchicum autumnale* L.; *Erythronium dens-canis* L.; *Fritillaria gussichiae* (Degen & Dörfler) Rix; \**Lilium martagon* L.; *Muscari comosum* (L.) Mill.; *Ornithogalum umbellatum* L.; *Paris quadrifolia* L.; *Polygonatum latifolium* (Jacq.) Desf.; \**P. odoratum* (Miller) Druce; \**Veratrum album* subsp. *lobelianum* (Bernh.) Reichenb.

**Orchidaceae:** *Cephalanthera damasonium* (Mill.) Druce; *C. longifolia* (L.) Fritsch; *C. rubra* (L.) L. C. M. Richard; *Dactylorhiza cordigera* (Fries) Soó; *D. maculata* (L.) Soó; *D. saccifera* (Brongn.) Soó; *Listera ovata* (*Neottia ovata*) (L.) R. Br.; *Neottia nidus-avis* (L.) Rich.; *Orchis coriophora* L.; \**O. pallens* L.; \**Platanthera bifolia* (Custer) Reichenb.f.; \**P. chlorantha* (L.) L. C. M. Richard.

**Poaceae:** *Agrostis canina* L.; *A. capillaris* L.; *A. stolonifera* L.; *Alopecurus pratensis* L.; \**Anthoxanthum odoratum* L.; *Arrhenatherum elatius* (L.) Beauv. ex J. Presl et C. Presl; *Brachypodium pinnatum* (L.) Beauv.; *B. sylvaticum* (Hudson) Beauv.; \**Briza media* L.; *Bromus mollis* L.; *B. racemosus* L.; *Calamagrostis arundinacea* (L.) Roth; *C. epigeios* (L.) Roth; *Cynosurus cristatus* L.; *C. echinatus* L.; *Dactylis glomerata* L.; *Danthonia alpina* Věst; *Deschampsia caespitosa* (L.) Beauv.; *Festuca drymeja* Mert. et Koch.; *F. heterophylla* Lam.; *F. nigrescens* Lam.; *F. pratensis* Hudson; *F. rubra* L.; *F. rupicola* Heuffel; *F. valesiaca* Schleich. ex Gaud.; *Holcus lanatus* L.; *H. mollis* L.; *Hordelymus europaeus* (L.) Nevski; *Lerchenfeldia flexuosa* (L.) Schur; *Lolium perenne* L.; *Melica uniflora* Retz.; *Milium effusum* L.; *Nardus stricta* L.; *Phleum pratense* L.; *Poa angustifolia* L.; *P. annua* L.; *P. bulbosa* L.; *P. compressa* L.; *P. nemoralis* L.; *P. pratensis* L.; *P. trivialis* L.; *Sesleria coerulans* Friv.

## LARGER FUNGI

### Ascomycota

### Leotiomycetes

**Rhytismatales:** *Cudoniaceae:* *Spathularia flavida* Pers.: Fr.

### Pezizomycetes

### Pezizales

**Discinaceae:** *Gyromitra esculenta* (Pers.) Fr.

**Helvellaceae:** *Helvella lacunosa* Afzel.

**Pezizaceae:** *Peziza badia* Pers.

**Pyronemataceae:** *Humaria hemisphaerica* (F. H. Wigg.: Fr.) Fuckel

**Sordariomycetes**

**Xylariales**

**Diatrypaceae:** *Diatrype disciformis* (Hoffm.: Fr.) Fr.

**Xylariaceae:** *Kretzschmaria deusta* (Hoffm.: Fr.) P. M. D. Martin

**Basidiomycota**

**Agaricomycetes**

**Agaricales**

**Agaricaceae:** *Agaricus arvensis* Schaeff.; *Calvatia utriformis* (Bull.: Pers.) Jaap; *Lepiota clypeolaria* (Bull.: Fr.) P. Kumm.; *Lycoperdon echinatum* Pers.: Pers.; *L. mammiforme* Pers.: Pers.; *L. perlatum* Pers.: Pers.

**Amanitaceae:** *Amanita fulva* (Schaeff.) Fr.; *A. gemmata* (Fr.) Bertill.; *A. muscaria* (L.: Fr.) Pers.; *A. pantherina* (DC.: Fr.) Krombh.; *A. rubescens* Pers.: Fr.; *A. vaginata* (Bull.: Fr.) Lam.

**Cortinariaceae:** *Cortinarius cinnamomeus* (L: Fr.) Fr.

**Hydnangiaceae:** *Laccaria laccata* (Scop.: Fr.) Cooke

**Hygrophoraceae:** *Crysomphalina chrysophylla* (Fr.: Fr.) Clémençon, *Hygrocybe persistens* (Britzelm.) Singer var. *persistens*

**Marasmiaceae:** *Gymnopus dryophilus* (Bull.: Fr.) Murrill.; *G. peronatus* (Bolton: Fr.) Antonín, Halling et Noordel.; *Marasmiellus perforans* (Hoffm. et Fr.) Antonín, Halling et Noordel.; *M. rotula* (Scop.: Fr.) Fr.; *Marasmius oreades* (Bolton: Fr.) Fr.; *Megacollybia platyphylla* (Pers.: Fr.) Kotl. et Pouzar; *Mycetinus scorodoni* (Fr.: Fr.) A. W. Wilson

**Mycenaceae:** *Mycena pura* (Pers.: Fr.) P. Kumm.; *M. rosea* (Schumach.) Gramberg

**Physalacriaceae:** *Oudemansiella mucida* (Schrad.: Fr.) Höhn.

**Pluteaceae:** *Pluteus cervinus* (Schaeff.) P. Kumm.

**Psathyrellaceae:** *Coprinellus micaceus* (Bull.: Fr.) Vilgalys, Hopple et Jacq. Johnson

**Schizophyllaceae:** *Schizophyllum commune* Fr. : Fr.

**Strophariaceae:** *Galerina hypnorum* (Schrank: Fr.) Kühner; *Gymnopilus penetrans* (Fr.: Fr.) Murrill.; *Hypholoma fasciculare* (Huds.: Fr.) P. Kumm.

**Tricholomataceae:** *Clitocybe gibba* (Pers.: Fr.) P. Kumm.; *C. odora* (Bull.: Fr.) P. Kumm.; *Lepista sordida* (Fr.: Fr.) Singer; *Rickenella fibula* (Bull.: Fr.) Raitelh.

**Boletales**

**Boletaceae:** *Boletus edulis* Bull.: Fr.; *B. subtomentosus* L.; *Leccinum aurantiacum* (Bull.) Gray; *L. scabrum* (Bull.: Fr.) Gray; *Neoboletus luridiformis* (Rostk.) Gelardi, Simonini & Vizzini; *Xerocomellus chrysenteron* (Bull.) Sutara



Fig. 2. *Suillus grevilleii* (Klotzsch : Fr.) Singer

**Gomphidiaceae:** *Chroogomphus helveticus* (Singer) M. M. Moser  
**Suillaceae:** *Suillus bovinus* (L.: Fr.) Roussel; *S. granulatus* (L.: Fr.) Roussel;  
*S. grevillei* (Klotzsch: Fr.) Singer (**Fig. 2**); *S. luteus* (L.: Fr.) Roussel; *S. variegatus*  
(Sw.: Fr.) Richon et Roze

### **Cantharellales**

**Cantharellaceae:** *Cantharellus cibarius* Fr.: Fr. var. *cibarius*

**Clavulinaceae:** *Clavulina rugosa* (Bull.: Fr.) Schröt.

**Hydnaceae:** *Hydnum repandum* L.: Fr. f. *repandum*

### **Gomphales**

**Gomphaceae:** *Ramaria botrytis* (Pers.: Fr.) Ricken

**Lentariaceae:** *Lentaria byssiseda* Corner

### **Phallales**

**Phallaceae:** *Phallus impudicus* L.: Pers.

### **Polyporales**

**Fomitopsidaceae:** *Fomitopsis pinicola* (Sw.: Fr.) P. Karst.; *Phaeolus  
schweinitzii* (Fr.: Fr.) Pat.

**Polyporaceae:** *Fomes fomentarius* (L.: Fr.) J. J. Kickx; *Polyporus badius*  
(Pers.) Schwein.; *P. leptcephalus* (Jacq.: Fr.) Fr.; *P. tuberaster* (Jacq.: Fr.) Fr.;  
*Pycnoporus cinnabarinus* (Jack.: Fr.) P. Karst.; *Trametes hirsuta* (Wulfen: Fr.)  
Pilát; *T. versicolor* (L.: Fr.) Lloyd; *Trichaptum abietinum* (Pers. ex J. F. Gmel. : Fr.)  
Ryvarden; *T. biforme* (Fr.) Ryvarden

### **Russulales**

**Auriscalpiaceae:** *Auriscalpium vulgare* Gray

**Bondarzewiaceae:** *Bondarzewia montana* (Quél.) Singer

**Russulaceae:** *Lactarius aurantiacus* (Pers.: Fr.) Gray; *L. deliciosus* (L.: Fr.)  
Gray; *L. deterrimus* Gröger; *L. piperatus* (L.: Fr.) Pers.; *Russula cyanoxantha*  
(Schaeff.) Fr.; *R. delica* Fr.; *R. densifolia* Gillet; *R. grisea* (Pers. ) Fr.; *R. vesca* Fr.

**Stereaceae:** *Stereum hirsutum* (Willd.: Fr.) Gray; *S. subtomentosus* Pouzar

### **Dacrymycetes**

#### **Dacrymycetales**

**Dacrymycetaceae:** *Calocera cornea* (Batsch.: Fr.) Fr.

#### **Tremellomycetes**

#### **Tremellales**

**Tremellaceae:** *Tremella mesenterica* Retz.: Fr.

## CONFLICT OF INTERESTS

The authors declare that there is no conflict of interests regarding the publication of this article.

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