

Ecology and chorology of 51 selected fungal species

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Peter Otto
University of Leipzig, Institute of Biology
Herbarium Universitatis Lipsiensis (LZ)
Johannisallee 21-23
D - 04103 Leipzig, Germany

E-mail: otto@uni-leipzig.de
Telefax: ++49 341 9738549

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1. *Amanita caesarea* (Scop.: Fr.) Pers.

geography

global distribution: Europe, Asia (Caucasus, Turkey, Siberia, Japan), Africa (Algeria, Morocco), North America (Mexico, USA, Canada)

distribution in Europe: ## The species mainly occurs from the lowlands to the lower mountainous regions, only seldom above 1200 msm (Italy).

areal diagnosis for Europe: ##

frequency

number of current known sites: more than 500

centres of abundance: ## Italy

changes in frequency: For Austria, Czech Republic, Macedonia, Montenegro, Portugal, Slovakia, Slovenia a moderate to strong decrease has been noticed for the last decades. E.g. for France and Greece no changes of frequency were announced. For Romania even an increase of sites is reported.

symbiont

It is an ectomycorrhizal fungus most often in symbiosis with *Quercus* species (*cerris*, *frainetto*, *gussonei*, *ilex*, *leptobalana*, *petraea*, *pubescens*, *robur*, *suber*), but also in ectomycorrhiza with *Castanea sativa* (Austria, Portugal, Spain), and *Fagus sylvatica* (Germany, Macedonia, Serbia,

Slovakia, Slovenia). Outside the family of Fagaceae the fungus is reported to be also a symbiont of *Corylus spec.* (Spain), *Tilia spp.* (Serbia), *Abies borisii-regis* (Greece), and *Pinus sylvestris* (Germany).

habitat

vegetation: The fungus mainly occurs in deciduous to sclerophyllous forests with *Quercus* spp. (associated trees belong e.g. to *Carpinus*, *Fraxinus*, *Ostrya*), less often in forests with *Fagus* and *Castanea* (see also chapter “symbiont”), and in forests where *Quercus* is mixed with conifers (*Picea* in Romania, *Pinus* e.g. in Italy, Slovenia, and Ukraine). Also wood pastures with oaks (*Dehesa*, *Montado*) in Portugal and Spain, *macchia* (with *Arbutus*, *Cistus*, and *Erica*), heaths (with *Calluna*), both in Italy, as well as extensively managed grasslands with solitary trees are suitable habitats (Slovenia). Outside the Mediterranean region the species is largely limited to thermophilous vegetation types (mostly forests with *Quercus*, in Poland a steppe-like vegetation with *Stipa*).

syntaxa of vegetation: *Carpinion* (Slovakia), *Carpino orientalis-Quercetum petraeae*, *Cytiso nigricantis-Quercetum petraeae*, *Quercetum petraeae-cerris* (all Romania), *Asperulo taurinae-Carpinetum*, *Luzulo-Fagetum*, *Luzulo-Quercetum* (all Hungary), *Querco-Ostryetum carpinifoliae*, *Seslerio-Ostryetum carpinifoliae* (both Montenegro), *Festuco heterophyllae-Fagetum*, *Querco-Carpinetum*, *Quercetum frainetto-cerris* (all Macedonia), *Quercion ilicis*, *Viburno-Quercetum ilicis* subass. *ornetosum*, *Erico-Quercetum cerridis*, *Tuberario lignosae-Callunetum*, *Physospermo-Quercetum petraeae* (all Italy), *Lithospermo-Quercetum?* (Poland)

Natura 2000 habitats: ##

soil requirements: In the Mediterranean region the species prefers dry to moderate damp soils (only in Spain also on wet soils) with acid pH-value (less often on basic soils; soil types: e.g. sands of the Miocene, red-greyish soils of non-calcareous materials, sandstone, phyllite, sandy brown soil, ranker). In the Northern Sub-Mediterranean and the Southern temperate region (Northern part of its area) the fungus is limited to warm and comparatively dry places with basic and often skeletal soils (e.g. limestone, *rendzina*, calcareous clay, e.g. Czech Republic, Germany, Slovenia) or acid soils (e.g. diorite, brown soil, *podzol*, e.g. Bulgaria, Hungary and Romania). In general the nitrogen content must be low to moderate, at places with thick litter layers the fructification is suppressed.

indicator value

In general, the species seems to be a good indicator for nitrogen-poor soils and especially in temperate regions for warm habitats.

synanthropy

The species occurs in natural and near-natural forests as well as in plantations strongly influenced by man (Spain).

occurrence of fruitbodies

The basidiocarps are mainly produced from early summer till autumn (July – October), in the Mediterranean region (Spain) the fruitbodies occur already from May onwards till October.

threats

In the European scale the fungus is vulnerable (?). Sites are mainly threatened by silvicultural intensification (e.g. fertilization, clear felling, pesticides), irresponsible picking, and nitrogen deposits from air pollution.

status of conservation

The species is red listed in Austria, Bulgaria, Czech Republic, Germany, Hungary, Montenegro, Poland, Portugal, Serbia, Slovakia, and Ukraine (in France only in regional lists).

It is protected by law in Croatia, Czech Republic, Germany, Serbia, Slovakia, Slovenia, and Ukraine.

2. *Amanita friabilis* (Karsten) Bas

geography

global distribution: Europe, Asia (Caucasus), North America (Greenland) ?
(in Bern Convention sheet: “not known outside Europe”)

distribution in Europe: ## The species mainly occurs from the lowlands to the mountainous regions, only seldom higher and than up to 1800 - 1900 msm (in symbiosis with *Alnus viridis*, Austria, Italy, Switzerland).

areal diagnosis for Europe: ##

frequency

number of current known sites: about 100

centres of abundance: Finland, France, Germany, Sweden

changes in frequency: For France and Sweden a decrease is reported for the last decades. E.g. in Estonia no changes have been noticed. For UK even an increase of sites is reported (**due to an increase of field research?**).

symbiont

It is an ectomycorrhizal fungus always in symbiosis with *Alnus* (*glutinosa*, *incana*, *viridis*).

habitat

vegetation: The species is limited to forests, groves and bushes with *Alnus* in wet to temporarily flooded biotopes. The fungus is reported for the following vegetation types: alder forests (e.g. Sweden), alder forests with *Filipendula* (Estonia), alluvial forests (e.g. Germany), swamp woods (Czech Republic), forested creek, stream and sea banks, subalpine bushes with *Alnus viridis*.

syntaxa of vegetation: *Alnion glutinosae* (e.g. Czech Republic), *Alno-Ulmion*, , *Alno-Padion*, *Stellario nemorum-Alnetum glutinosae*, *Alnetum incanae*, *Pruno-Fraxinetum* (all Germany)

Natura 2000 habitats: **Dehesas with evergreen *Quercus* spp. (code 6310, Portugal)?, Fennoscandian herb-rich forests with *Picea abies* (code 9050, France)?**, Fennoscandian deciduous swamp woods (code 9080, Finland), Alluvial forests with *Alnus* and *Fraxinus* (code 91EO, Austria, Belgium, Croatia, Czech Republic, Estonia, France, Germany, Italy, Latvia, Slovenia, Spain, Sweden, Switzerland, UK)

soil requirements: The fungus is restricted to wet soils (high groundwater level) and tolerate a temporarily flooding. In respect of pH-value the species is euryoecious (range from acid to basic). According to the ecological requirements of *Alnus* the fungus occurs on nutrient rich to moderate rich soils, e.g. gley, peat soils, silicate sands, vega. The thickness of the litter layer is reported as variable.

indicator value

The species is a characteristic **fungus element** of natural or near-natural *Alnus* biotopes and of wetland habitats in general.

synanthropy

The species avoids habitats considerably influenced by man.

occurrence of fruitbodies

The basidiocarps are mainly produced in late summer and autumn (August – October), in Russia fruitbodies were already found in May, in Finland from June till October. In Italy a very unregular fructification was observed (only every 5-10 years).

threats

In the European scale the fungus is endangered (?). Sites are mainly threatened by drainage and deforestation.

status of conservation

The species is red listed in Austria, Czech Republic, Estonia, Finland, France, Germany, Hungary, Norway, Slovakia, **Spain**, Sweden, Switzerland, and The Netherlands.

3. *Amylocystis lapponica* (Romell) Bondartsev & Singer

geography

global distribution: Europe, Asia (Siberia), North America (USA)

distribution in Europe: ## The species mainly occurs in the lowlands, only exceptionally in lower mountainous regions (Bulgaria, Croatia, Czech Republic, Sweden).

areal diagnosis for Europe: ##

frequency

number of current known sites: about 1000

centres of abundance: Finland, Sweden

changes in frequency: In Finland and Sweden a decrease has been noticed for the last 50 years.

substratum

The fungus is lignicolous saprobic and probably exclusively colonizing trunks (**always lying?**) of *Picea abies*, moderately decayed and often partly corticated. **There is one (debatable) record for *Abies alba* (Bulgaria) and another for *Larix decidua* (Italy)**. In Finland the species is frequently associated with *Fomitopsis rosea*, *Phlebia centrifuga*, and *Phellinus ferrugineofuscus*.

habitat

vegetation: The species nearly exclusively occurs in boreal old-growth forests with *Picea abies* (*Vaccinium myrtillus* and others). In Estonia the fungus was found in a rather nitrogen rich boreo-nemoral coniferous forest (Aegopodium type). The sites in Croatia and Slovakia are characterized as virgin beech-spruce-fir forests, for the Czech Republic a natural spruce forest is recorded.

syntaxa of vegetation: *Piceion excelsae* (Slovakia), *Bazzanio-Piceetum* (Czech Republic), *Vaccinio-Piceetum* (Bulgaria)

Natura 2000 habitats: Western taiga (code 9010, **Bulgaria?**, Estonia, Finland, Sweden), Fennoscandian herb-rich forests with *Picea abies* (code 9050, Finland), Acidophilous *Picea* forest of the montane **to the alpine** levels (code 9410, Slovenia), Alpine *Larix decidua* and/or *Pinus cembra* forests (code 9420, Italy)

soil requirements: Because the species is lignicolous soil characters should be without relevance. According to the ecological preferences of *Picea abies* the soils of the sites are wet to damp and more or less acid.

indicator value

The species is a very good indicator for virgin spruce forests.

synanthropy

The species is mainly restricted to natural forests and is to be regarded as anthropophobic.

occurrence of fruitbodies

The basidiocarps are produced from summer till autumn (July - October).

threats

In the European scale the fungus is critically endangered (?). Sites are mainly threatened by silvicultural intensification (first of all clear felling).

status of conservation

The species is red listed in Czech Republic, Estonia, Finland, Norway, Poland, Slovakia, Sweden, and regional red listed in Russia. It is protected by law in Croatia, Czech Republic and Slovakia (the single known locality in Slovakia is protected as nature reserve). By far the majority of current known sites is located in Sweden. That's why this country has a particular responsibility for the maintenance of this species in Europe.

4. Antrodia albobrunnea (Romell) Ryvarden

geography

global distribution: Europe, Asia (Siberia), North America (USA)

distribution in Europe: ## The species mainly occurs in the lowlands, only exceptionally in mountainous regions (Spain, Sweden).

areal diagnosis for Europe: ##

frequency

number of current known sites: about 400

centres of abundance: Finland, Sweden

changes in frequency: In Finland, Lithuania and Sweden a decrease has been noticed for the last 50 years.

substratum

The fungus is lignicolous saprobic and probably exclusively colonizing coarse wood of *Pinus sylvestris*. **There is only one (debatable) record for *Picea abies* (Lithuania)**. The colonized pine wood is decorticated and mostly fairly to advanced decayed. The species is typical for lying trunks, **from Lithuania it is also recorded for stumps**. The Finnish report emphasises the frequent occurrence on fallen kelo trees (several hundred years ago died, debarked, standing pines).

habitat

vegetation: The species inhabits rather dry coniferous forests with Scots pine. There is a striking preference for boreal forests. **In one case the fungus was found in a mixed forest plantation in the Ukrainian steppe zone (specimen in the National Herbarium of Ukraine, KW)**.

syntaxa of vegetation: Dicrano-Pinion (Poland)

Natura 2000 habitats: Western taiga (code 9010, Finland, Lithuania, Sweden), Coniferous forests on, or connected to, glaciofluvial eskers (code 9060, Finland, Lithuania, Sweden), Acidophilous Picea forest of the montane **to the alpine** levels (code 9410, France), Mediterranean pine forest with endemic black Pinus (code 9535, Italy, **native in Italy?**)

soil requirements: Because the species is lignicolous soil characters should be without relevance. According to the ecological preferences of Pinus sylvestris the soils of the sites are more or less dry and acid.

indicator value

The species is a good indicator for unmanaged old boreal pine forests.

synanthropy

The species is mainly restricted to natural and near-natural forests.

occurrence of fruitbodies

The basidiocarps are produced from summer till autumn (July - October).

threats

In the European scale the fungus is critically endangered (?). Sites are mainly threatened by silvicultural intensification (##).

status of conservation

The species is red listed in Finland, Norway, Poland, **Spain** and Sweden.

5. Armillaria ectypa (Fr.) Singer

geography

global distribution: Europe, Asia (Japan)

distribution in Europe: ## The species mainly occurs in the lowlands, only seldom in mountainous regions (Germany, in France also above 1200 msm).

areal diagnosis for Europe: ##

frequency

number of current known sites: about 50

centres of abundance: Finland, France, Germany, Sweden

changes in frequency: For Denmark, Finland, France, Germany, and Sweden a decrease has been noticed for the last 50 years. For UK even an increase of sites is reported (**due to an increase of field research?**).

substratum

Probably it is a saprobic fungus decaying peat mosses (Sphagnum spp.), sedges (e.g. Carex rostrata) and presumably also reed (Phragmites australis, UK), **possibly also with a potential to invade living plants (France)**.

habitat

vegetation: The fungus mainly inhabits transitional mires and is associated with Sphagnum spp. and Carex spp., but not seldom also with e.g. Eriophorum latifolium, Menyanthes trifoliata. Occasionally it also occurs in ombrogenic mires (with Andromeda polifolia, Betula nana, Vaccinium oxycoccus etc., in Sweden in aapa mires), in reeds dominated by sedges, at paludified pond shores (e.g. Finland), in

alkaline fens (e.g. Sweden) and near calcareous springs (Denmark, Germany). **There is a (debatable) old record for a fresh pine forest (*Leucobryo-Pinetum molinietosum*) for Poland, and a doubtful record for a meadow steppe with rare trees of *Pyrus*, *Acer* and bushes (Ukraine).**

syntaxa of vegetation: Scheuchzerio-Caricetea fuscae (Czech Republic), Caricetalia fuscae (France), Oxycocco-Sphagneteta (e.g. France), Sphagnetum magellanici, Cratoneurion commutati, Caricion davallianae, Primulo-Schoenetum ferruginei, Magnocaricion, Caricion elatae, Caricetum rostratae (all Germany),

Natura 2000 habitats: Calcareous fens with *Carex lasiocarpa* (code 6410, Switzerland), Active raised bogs (code 7110, Austria, Belgium, France), Blanket bog (code 7130, France, UK), Transition mires and quaking bogs (code 7140, Czech Republic, Finland, France, Germany), Depressions on peat substrates (code 7150, Czech Republic), Fennoscandian mineral-rich springs and springfens (code 7160, Finland), Semi-natural tall herb humid meadow (code 7210, Switzerland), Petrifying spring with tufa formation (code 7220, Denmark), Alkaline fens (code 7230, Denmark, Finland, Germany, Sweden, UK), Aapa mires (code 7310, Sweden)

soil requirements: The species colonises peat and organotrophic substrates respectively (pure ones or with a low mineral amount). The pH-value differs from strong acid to more or less basic, the nitrogen content must be very low (oligotrophic) or rather low (mesotrophic). The substrates below the peat layers differ considerably (not of strong influence for the occurrence of the fungus). Reported are sandstone, agglomerate, claystone, crystalline rocks (all Czech Republic), but also limestone (Germany).

indicator value

The species is a good indicator for undisturbed or only weakly influenced bogs and mires.

synanthropy

The species is restricted to natural and near-natural bogs and mires.

occurrence of fruitbodies

The basidiocarps are produced from early summer till late autumn (June - November).

threats

In the European scale the fungus is critically endangered (?). The number of sites were decreased mainly by large-scale draining of bogs and mires.

status of conservation

The species is red listed in Austria, Czech Republic, Denmark, Finland, France, Germany, Sweden, Switzerland, The Netherlands and UK.

6. *Bankera fuligineo-alba* (J.C. Schmidt: Fr.) Pouzar

geography

global distribution: Europe, Asia (Siberia, Japan), North America (Canada, USA, symbiosis e.g. with *Pinus banksiana*)

distribution in Europe: ## The species mainly occurs in the lowlands, occasionally in mountainous regions, and only very seldom above 1200 msm (Armenia, Italy).

areal diagnosis for Europe: ##

frequency

number of current known sites: about 100

centres of abundance: ## Germany, Poland

changes in frequency: For Armenia, Czech Republic, Denmark, France, Germany, The Netherlands a decrease is reported for the last decades (e.g. no records for The Netherlands since 1968). In Estonia and Poland no changes have been noticed. For UK even an increase of sites is reported (**due to an increase of field research?**).

symbiont

The fungus lives ectomycorrhizal and always in symbiosis with Pinus, nearly always with *P. sylvestris*, in Denmark in dunes also with *P. mugo* (records for *Picea* were regarded as confused with *Bankera cinerea*). **In Ukraine fruitbodies were found on strongly decayed wood.**

habitat

vegetation: The species mainly inhabits nutrient poor pine forests (including dunes with pines), often rich on terrestrial mosses (e.g. *Dicranum* spp.) and lichens (e.g. *Cladonia* spp., typical seed plants are e.g. *Avenella flexuosa*, *Vaccinium vitis-idaea*). The fungus was occasionally found in pine plantations (e.g. afforestations in former brown coal mining areas, Germany), and exceptionally in parks. In the Mediterranean region it also was found in sclerophyllous forests with pine and *Quercus ilex* and in chestnut coppices with pine (Italy). Typical associated fungi are e.g. *Boletopsis grisea*, *Sarcodon squamosus*, and *Tricholoma focale*.

syntaxa of vegetation: Dicrano-Pinion, Dicrano-Pinetum (= Cladonio-Pinetum, = Leucobryo-Pinetum, both e.g. Germany, Poland), Peucedano-Pinetum (Poland), Quercion ilicis (Italy)

Natura 2000 habitats: ##

soil requirements: The fungus colonises distinct acid, dry to more or less fresh soils. They are always nitrogen poor, and more or less sandy (often podzol, weathered Gabbro, Italy), a litter layer is absent or thin.

indicator value

The fungus is characteristic for natural and near-natural oligotrophic pine forests.

synanthropy

The species tolerates a moderate anthropogenic influence in terms of planting (also the mountainous *Pinus mugo* in the lowlands).

occurrence of fruitbodies

The basidiocarps are mainly produced from summer to late autumn (July – November), in UK already in June and still in December.

threats

In the European scale the fungus is endangered (?). Sites are mainly threatened by eutrophication and silvicultural intensification.

status of conservation

The species is red listed in Armenia, Czech Republic, Estonia, France, Germany, Poland, The Netherlands and UK. It is protected by law in Estonia.

7. *Battarrea phalloides* (DICKS.) PERS.

Synonym: *Battarrea stevenii* (LIBOSCH.) FR.

geography

global distribution: Europe, Africa (North Africa), North America (Mexico, USA), Australia.

distribution in Europe: The fungus is rather widespread from the Mediterranean to the nemoral zone. It is mainly restricted to the lowlands, in Armenia, Macedonia, Russia, and Spain it is also found in lower mountainous regions. In aspect of continentality the species is indifferent.

areal diagnosis for Europe: meridional-temperate / euoceanic-eucontinental.

frequency

number of current known sites: about 150

centres of abundance: The species is rather common in Spain, southern England and along the Atlantic coast of southern France. Surely the few records in the continental Eastern Europe don't reflect the real frequency in this region.

changes in frequency: There are no indications for strong and large-area frequency changes. A decrease of the species is reported from Armenia, Hungary, and Poland.

substratum

It is a saprobic species, normally decaying leaf litter and subterranean organic material (e.g. rhizomes and roots of Poaceae). In United Kingdom the species was found several times associated with decaying wood (kind of wood not reported), and also was found inside of hollow trees facing towards the sun. Presumable two ecotypes exist, a widespread herbicolous and an atlantical lignicolous.

habitat

vegetation: The fungus occurs in steppes (Hungary, Russia, Ukraine), steppe-like grasland (Germany), dunes (France) and on sunny edges and in gaps of different kinds of woodlands, deciduous (Robinia [Hungary and Ukraine], Populus, Salix [Bulgaria]), mixed (e.g. Pinus and Robinia [Serbia]), and coniferous (Cedrus, Cupressus, Juniperus, Pinus [France], Cupressus [Greece and Ukraine], Juniperus [Macedonia]). Rather often the species colonises anthropogenic biotopes as hedges, roadsides, gardens, parks, and cemeteries (e.g. France, Poland, United Kingdom), in Germany repeatedly found in nitrophilous coppices with Sambucus nigra, Urtica dioica etc.

syntaxa of vegetation: Juniperetum exelsae, Querco-Carpinetum orientalis, Coccifero-Carpinetum orientalis (all Macedonia), Junipero-Populetum albae (Hungary).

Natura 2000 habitats: Pannonic sand steppes (code 6260, Hungary), coastal dunes with *Juniperus* spp. (code 2250, France).

soil requirements: The fungus prefers sandy soils, but from Czech Republic it is also recorded from clay and cretaceous rocks. In humid areas dry soils are colonized, in more semiarid areas (e.g. parts of Spain, Armenia) the soils are comparatively wet. The pH-value is neutral to basic. A litter layer is absent to rather thick.

indicator value

In humid areas the species indicates sunny dry places.

synanthropy

Especially in temperate Europe the species rather often occurs in anthropogenic habitats.

occurrence of fruitbodies

The basidiocarps are produced from summer till early winter (June-December). Especially the stipe is rather persistent. That's why the fungus can be identified all over the year.

threats

In the European scale the fungus is not endangered. Sites are threatened by eutrophication, pesticides, and afforestation.

status of conservation

The species is red listed in Armenia, Austria, Czech Republic, France, Germany, Hungary, Macedonia, Poland, Serbia, Spain, and United Kingdom. It is protected by law in Serbia, and United Kingdom.

8. *Boletopsis grisea* (Peck) Bondartsev & Singer

including *Boletopsis perplexa* Watling & Milne

remark: *Boletopsis perplexa*, described from Scotland 2007 is also living in symbiosis with pine.

geography

global distribution: Europe, Asia (Siberia), North America (USA)

distribution in Europe: ## The species mainly occurs in the lowlands, occasionally in mountainous regions (e.g. Czech Republic, Poland, Spain, Sweden).

areal diagnosis for Europe: ##

frequency

number of current known sites: about 250

centres of abundance: Finland, Sweden

changes in frequency: For Czech Republic, Denmark, Germany, and Sweden a decrease is reported for the last 4 to 6 decades (e.g. no records for Denmark since 1963). In contrast, in Estonia, Finland, and Poland no changes have been noticed.

symbiont

The fungus lives ectomycorrhizal and always in symbiosis with *Pinus sylvestris* (records for *Picea* were regarded as confused with *Boletopsis leucomelaena*).

habitat

vegetation: The species mainly inhabits oligotrophic boreal Scots pine forests and heath forests dominated by pines (*Calluna-Vaccinium* undergrowth), often rich on terrestrial mosses (e.g. *Dicranum* spp.) and lichens (e.g. *Cladonia* spp). In Poland the fungus also occurs on inland sand dunes with pine, in France also in pine forests mixed with *Cedrus*.

syntaxa of vegetation: *Pinetalia sylvestris* (France), *Dicrano-Pinion*, *Dicrano-Pinetum* (= *Cladonio-Pinetum*, = *Leucobryo-Pinetum*, both e.g. Germany, Poland).

Natura 2000 habitats: Western taiga (code 9010, Estonia, Finland, Sweden), Acidophilous *Picea* forest of the montane **to the alpine** levels (code 9410, Switzerland), Coniferous forests on, or connected to, glaciofluvial eskers (code 9060, Finland, Sweden), Subalpine and montane *Pinus uncinata* forests (code 9430, Spain)

soil requirements: The fungus colonises acid to neutral, in humid areas more or less dry soils (for Spain comparatively wet soils were reported). They are always nitrogen poor, and more or less sandy (often podzol), a litter layer is absent or thin.

indicator value

The fungus is characteristic for natural or near-natural oligotrophic pine forests and heath forests with pines.

synanthropy

The species is to be regarded as stenoeocious and anthropophobic.

occurrence of fruitbodies

The basidiocarps are produced from summer to late autumn (August – November).

threats

In the European scale the fungus is endangered (?). Sites are mainly threatened by eutrophication and silvicultural intensification.

status of conservation

The species is red listed in Czech Republic, Denmark, France, Germany, Norway, Poland, **Spain**, and Sweden.

9. Boletus dupainii Boud.

geography

global distribution: Europe, North America (USA)

distribution in Europe: ## The species mainly occurs in the lowlands, only at warm places also in the mountainous zone (France, Russia; Serbia, in Italy up to 1450 msm).

areal diagnosis for Europe: ##

frequency

number of current known sites: about 100

centres of abundance: mainly France, partly Italy and Spain

changes in frequency: For Austria and Slovenia a decrease is reported for the last 3 decades. In France and Hungary no changes have been noticed.

symbiont

It is an ectomycorrhizal fungus always in symbiosis with Quercus (cerris, ilex, petraea, pubescens, suber; **also rotundifolia?**) or (exceptionally) Castanea sativa.

habitat

vegetation: The species mainly inhabits distinct thermophilous deciduous forests dominated by Quercus, often old growth and natural or semi-natural (e.g. Slovenia, associated trees, e.g. Carpinus, Fagus). In Italy the species also colonises sclerophyllous forests with Quercus. In Hungary the fungus was found once in a chestnut plantation.

syntaxa of vegetation: Quercetalia pubescenti-sessiliflorae, Quercetalia ilicis, Cephalanthero Fagion, Carpinion p.p.: Rubio-Fagetum, Aceri monspessulani-Fagetum, Rusco-Quercetum petraeae, Viburno lantanae-Quercetum petraeae (all France), Quercetum petraeae-cerris (Hungary)

Natura 2000 habitats: Medio-European limestone beech forests of the Cephalanthero-Fagion (code 9150, France, Germany, Slovenia), Sub-Atlantic and Medio-European oak or oak-hornbeam forests of the Carpinion betuli (code 9160, Switzerland), Galio-Carpinetum oak-hornbeam forests (code 9170, Austria), Quercus suber forests (code 9330, Italy), Quercus ilex and Qu. rotundifolia forests (code 9340, France, Italy). **Pannonic woods with Quercus petraea and Carpinus betulus (code 91GO, country?)**, Pannonian woods with Quercus pubescens (code 91HO, Croatia)

soil requirements: The species prefers basic soils (e.g. limestone, dolostone and dolomitic limestone fragments, clay, brown soil), but is also recorded from acid and neutral ones. It mainly colonises dry to fresh soils at warm (sunny) places (**from Slovenia it is also reported for wet soils**), the nutrient content is low to moderate, the litter layer must be absent or thin.

indicator value

The fungus is thermophilous and typical for Mediterranean and Sub-Mediterranean Quercus stands.

synanthropy

The species avoids habitats strongly influenced by man.

occurrence of fruitbodies

The basidiocarps are produced from summer to late autumn (July – November), in Croatia and Serbia already from May/June onwards to autumn.

threats

In the European scale the fungus is critically endangered. Sites are mainly threatened by degradation and deforestation of sclerophyllous forests and by silvicultural intensification in general.

status of conservation

The species is red listed in Austria, France, Germany, **Slovakia, Spain**, and Hungary. It is protected by law in Croatia and Slovenia. More than 50 percent of all current known sites are located in France and Italy. That's why these countries have a particular responsibility for the maintenance of this species in Europe.

10. Bovista paludosa Lév.

geography

global distribution: Europe, Asia (Himalaya), North America (USA, Canada)

distribution in Europe: ## The species mainly occurs in the lowlands, occasionally in lower mountainous regions (e.g. Poland, Romania, Ukraine) and seldom above 1200 msm (Austria, France, Spain).

areal diagnosis for Europe: ##

frequency

number of current known sites: about 150

centres of abundance: France, Germany, Sweden

changes in frequency: For Czech Republic, Estonia, Finland, France, Germany, Poland, and Sweden a decrease has been noticed for the last 50 years (e.g. no records for Czech Republic since 1985, for Estonia since 1959, for Poland since the early 1970s).

substratum

It is a saprobic fungus decaying dead plant material, probably mainly mosses (e.g. *Aulacomnium palustre*, *Calliergonella cuspidata*, *Drepanocladus* spp., *Sphagnum* spp.), but surely also remains of seed plants as sedges (*Carex* spp.), other Cyperaceae (e.g. *Eriophorum* spp., *Trichophorum cespitosum*) and Poaceae (*Molinia caerulea*). Conspicuously is the fructification within mosses.

habitat

vegetation: The fungus inhabits a rather wide range of wet mossy habitats. Records exist for mires (e.g. Finland, UK), alkaline fens (Germany, Sweden), spring fens (Estonia), wet heaths (UK), damp or boggy peat meadows (e.g. Poland) and for a meadow in a mountainous forest (Ukraine).

The species most often occurs in alkaline to neutral fens and wet meadows (characteristic plants are e.g. *Carex davalliana*, *Molinia caerulea*, *Parnassia palustris*), but also mires are suitable habitats (noteworthy seed plants are e.g. *Carex rostrata*, *Eriophorum angustifolium*, and *Trichophorum cespitosum*). The species mainly avoids oligotrophic and strong acid types of mires (records from Germany as *Sphagnetum magellanicum*). Associated fungi are e.g. *Entoloma griseocyaneum*, *E. mougeotii*, and *Lycoperdon caudatum* (Germany).

syntaxa of vegetation: *Caricetalia davallianae*, *Caricion incurvae*, *Eriophorion scheuchzeri*, *Caricion bicoloris-atrofuscae* (all France), *Oxycocco-Sphagnetum*, *Eriophoro-Trichophoretum cespitosi*, *Sphagnetum magellanicum*, *Cratoneurion commutati*, *Caricion davallianae*, *Orchio-Schoenetum nigricantis*, *Primulo-Schoenetum ferruginei*, *Scheuchzerio-Caricetum fuscae*, *Caricion fuscae*, *Calthion*, *Juncetum subnodulosi*, *Molinion caeruleae*, *Cladietum marisci* (all Germany), *Valeriano-Caricetum flavae* (Poland), *Caricetum diandrae* (Romania).

Natura 2000 habitats: *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (code 6410, Czech Republic, Romania), Active raised bogs (code 7110, Austria, Switzerland), Transition mires and quaking bogs (code 7140, Czech Republic, Finland), Fennoscandian mineral-rich springs and springfens (code 7160, Finland, Sweden), Calcareous fens (code 7210, Switzerland), Alkaline fens (code 7230, Estonia, Finland, France, Germany, Lithuania, Poland, Sweden, UK), Alpine pioneer formations of *Caricion bicoloris-atrofuscae* (code 7240, France)

soil requirements: The species colonises more or less pure organotrophic substrates (peat in a wide sense). The pH-value is mainly distinct basic, only exceptionally acid. The nitrogen content varies from obvious low (more or less oligotrophic) to moderate low (mesotrophic). For Estonia the nitrogen content is reported as high.

indicator value

The fungus is a good indicator for undisturbed or only weakly influenced fens and mires.

synanthropy

The species mainly occurs in natural and near-natural habitats (fens and mires), less often in semi-natural ones (extensively used meadows).

occurrence of fruitbodies

The basidiocarps are mainly produced from early summer till autumn (June – October), seldom already in May (Czech Republic).

threats

In the European scale the fungus is critically endangered (?). The number of sites were decreased mainly by large-scale draining of bogs and mires. The species is also threatened by eutrophication (e.g. nutrient enrichment suppresses mosses by promoting the development of seed plants).

status of conservation

The species is red listed in Austria, Czech Republic, Estonia, Finland, France, Germany, Montenegro, Norway, Poland, Serbia, **Slovakia ?**, Spain, Sweden, Switzerland, and UK. It is protected by law in Serbia.

11. Cantharellus melanoxeros Desm.

remark: *Cantharellus ianthinoxanthus* (Maire) Kühner is excluded here and is regarded as a separate species. Some authors consider this taxon as synonym to *melanoxeros* (it would name young, not well differentiated fruitbodies of *C. melanoxeros*).

geography

global distribution: limited to Europe

distribution in Europe: ## The species mainly occurs in the lowlands, occasionally also in mountainous regions (in France and Italy also above 1200 msm).

areal diagnosis for Europe: ##

frequency

number of current known sites: about 300

centres of abundance: mainly France, partly Germany, Italy, Spain, and Sweden

changes in frequency: For France a decrease has been noticed for the last 3 decades. **For Hungary and UK even an increase of sites is reported (probably due to an increase of field research?).**

symbiont

The species lives in ectomycorrhiza with *Fagus sylvatica* and *Quercus* spp. (**only robur and petraea?**), **in Sweden also with *Corylus avellana* (?)**, in France possibly with *Carpinus*.

habitat

vegetation: The species occurs in deciduous (e.g. together with *Castanea*, *Tilia*) and mixed forests (with *Pinus*). In Central Europe it prefers warm sites (there a moderate thermophilous fungus), in more Northern parts it inhabits boreo-nemoral oak forests (Estonia, Finland).

syntaxa of vegetation: *Carpinion betuli* (France), *Galio odorati-Fagetum*, *Hordelymo-Fagetum*, *Carici-Fagetum* (all Germany), *Luzulo nemorosae-Fagetum sylvaticae*, *Galio rotundifolio-Fagetum sylvaticae*, *Sorbo torminalis-Fagetum sylvaticae*, *Luzulo-Quercetum* (all Hungary)

Natura 2000 habitats: Fennoscandian hemiboreal natural old broad-leaved deciduous forests (code 9020, Estonia, Finland, Sweden), Fennoscandian herb-rich forests with *Picea abies* (code 9050, Finland), Fennoscandian wooded pastures (code 9070, Sweden), *Luzulo-Fagetum* beech forests (code 9110, Germany, Luxembourg, Switzerland), **Atlantic acidophilous beech forests with *Ilex* (code 9120, country?)**, *Asperulo-Fagetum* beech forests (code 9130, Austria, France, Germany, Luxembourg, Switzerland, UK), Medio-European limestone beech forests of the *Cephalanthero-Fagion* (code 9150, Denmark, Germany, Slovenia), Sub-Atlantic and Medio-European oak or oak-hornbeam forests of the

Carpinion betulae (code 9160, **UK? is Eu-Atlantic**), Galio-Carpinetum oak-hornbeam forests (code 9170, Austria, France, Slovenia, Switzerland), Old sessile oak woods (code 91AO, UK)

soil requirements: The fungus colonises rather dry to damp, mainly basic to neutral, but e.g. in Hungary also distinct acid soils (types e.g. brown soil above limestone and base-rich silicate bedrocks, marl, in Finland also podzol). The soils are more or less nutrient-poor, the grain size ranges from silt to clay. The litter layer has to be absent or thin.

indicator value

The species avoids nitrogen-rich soils and is in Central Europe moderate thermophilous.

synanthropy

The fungus is restricted to natural and near-natural forests.

occurrence of fruitbodies

The basidiocarps are mainly produced from summer to autumn (July – November), in UK still in December.

threats

In the European scale the fungus is vulnerable (?). Sites are mainly threatened by silvicultural intensification (e.g. fertilization, clear felling, planting of allochthonous trees) and by nitrogen deposits from air pollution.

status of conservation

The species is red listed in Austria, Denmark, Finland, France, Germany, Hungary, Norway, **Spain**, and Sweden. It is protected by law in Hungary. About 50 percent of all current known sites are located in France. That's why this country has a particular responsibility for the maintenance of this species in Europe.

12. Cortinarius ionochlorus Maire

geography

global distribution: not known outside Europe (?)

distribution in Europe: ## The species mainly occurs in the lowlands, occasionally also in lower mountainous regions (e.g. France, Spain).

areal diagnosis for Europe: ##

frequency

number of current known sites: about 180

centres of abundance: ## France, Spain

changes in frequency: For France no changes of frequency were announced.

symbiont

It is an ectomycorrhizal fungus in symbiosis with Quercus species (**only ilex, petraea, robur?**), **for Spain it is also recorded to be a symbiont of Pinus.**

habitat

vegetation: The fungus mainly inhabits more or less thermophilous deciduous (in Croatia with *Ostrya carpinifolia*) and sclerophyllous oak forests, occasionally also mixed forests (*Quercus*, *Pinus*), and macchia with *Quercus ilex*. The range of colonized vegetation types is rather narrow.

syntaxa of vegetation: Querceto-Potentilletum albae (Czech Republic), Quercion ilicis, Viburno-Quercetum ilicis subass. ornetosum (both Italy),

Natura 2000 habitats: Dehesas with evergreen *Quercus* spp. (code 6130, Portugal), Asperulo-Fagetum beech forests (code 9130, Germany), Medio-European limestone beech forests of the Cephalanthero-Fagion (code 9150, France), *Quercus ilex* forests (code 9340, France, Italy), Pannonian woods with *Quercus pubescens* (code 91HO, Croatia)

soil requirements:

The fungus is mainly restricted to basic soils, but also more or less neutral soils are colonized (types limestone, dolostone and dolomitic limestone, sandstone [all Italy]; granite [Spain]). In humid regions the species prefers more or less dry soils (e.g. Germany), in more arid regions (e.g. Spain) it was only found on comparatively wet soils (therefore widely constant moisture requirements). Probably, the nitrogen content is always distinct low to moderate low. It seems that the thickness of the litter layer has no influence on the fructification of the species.

indicator value

The species indicates in temperate regions thermophilous oak forests.

synanthropy

The species only occurs in natural and semi-natural woodlands (macchia as a degraded stage of sclerophyllous forests).

occurrence of fruitbodies

The basidiocarps are produced rather late in the year (September – October), in Italy till December.

threats

In the European scale the fungus is vulnerable (?). Sites are mainly threatened by silvicultural intensification (e.g. clear felling, planting of allochthonous trees, fertilization).

status of conservation

The species is red listed in **France**, Germany, and **Spain**. About 50 percent of all current known sites are located in France. That's why this country has a particular responsibility for the maintenance of this species in Europe.

13. *Entoloma bloxamii* (Fr.) Singer

geography

global distribution: Europe, Africa (Canary Islands), Asia (Japan), North America (USA)

distribution in Europe: ## The species mainly occurs in the lowlands, occasionally also in mountainous regions (in Italy in alpine grassland up to 2400 msm).

areal diagnosis for Europe: ##

frequency

number of current known sites: about 250

centres of abundance: France, Germany, Italy, Spain, Sweden, and UK

changes in frequency: For France, Germany, Lithuania, and Sweden a decrease has been noticed for the last decades, for Poland no records after 1917. For Estonia, Hungary, and The Netherlands no changes of frequency were announced. **For UK even an increase of sites is reported (due to an increase of field research?).**

substratum

The fungus lives saprobic terricolous by decomposing humus particles (also in forests from grassy and herbaceous species?).

habitat

vegetation: The species occurs in a wide range of habitats, mainly in extensively used and non-fertilized, and that's why mossy pastures and meadows (also in dunes and on slopes), but also in juniper heaths, alvar shrublands (Estonia), forest meadows, deciduous forests (Carpinus, Quercus [Hungary], Castanea, Fagus, Quercus [Italy]), coniferous forests (Cupressus [Italy], Picea [Czech Republic]), mixed forests (Fagus, Larix, Picea [Italy]), sclerophyllous forests, in macchia, and in strong anthropogenic biotopes (gardens [e.g. Czech Republic], cemeteries, and churchyards [UK]).

syntaxa of vegetation: forests: Carpinion betuli (Germany), Querco petraeae-Carpinetum transdanubicum (Hungary), Piceetum muscosum (Czech Republic), coppices: Prunetalia p.p. (France), Berberidion, Roso-Juniperetum (both Germany), grasslands: Festuco-Brometea, Ononidion striatae, Festuco-Seslerietea (all France), Mesobromion erecti, Xerobrometum, Mesobrometum, Gentiano-Koelerietum, Trinio-Caricetum humilis, Pulsatillo-Caricetum humilis, Carlino-Caricetum sempervirentis, Nardetum alpinum, Polygalo-Nardetum, Geranio-Trisetetum (all Germany)

Natura 2000 habitats: Semi-natural dry grasslands and scrubland facies (code 6120, Luxembourg), Siliceous alpine and boreal grasslands (code 6150, UK), Alpine and subalpine calcareous grasslands (code 6170, Slovenia, Switzerland, UK), Semi-natural dry grasslands and scrubland facies on calcareous substrates (code 6210, Austria, Croatia, Denmark, Estonia, France, Germany, Republic of Ireland, Sweden, Switzerland, UK), Species-rich Nardus grasslands on siliceous substrates in mountain areas (code 6230, Denmark, Republic of Ireland, UK), Fennoscandian lowland species-rich dry to mesic grasslands (code 6270, Sweden), Molinia meadows on calcareous, peaty or **clayey**-silt-laden soils (code 6410, UK), Lowland hay meadows (code 6510, Austria, Sweden, UK), Mountain hay meadows (code 6520, Austria, Sweden, UK), Fennoscandian wooded meadows (code 6530, Sweden), Fennoscandian hemiboreal natural old broad-leaved deciduous forests (code 9020, Lithuania, Sweden), Fennoscandian herb-rich forests with Picea abies (code 9050, Lithuania), Fennoscandian wooded pastures (code 9070, Sweden), Quercus suber forests (code 9330, Spain), Quercus ilex and Q. rotundifolia forests (9340, Spain)

soil requirements: The majority of records originates from distinct basic and rather dry soils, but also the occurrence on neutral and acid as well as fresh to wet soils is proved. The nitrogen content has to be low. The following soil types were reported: alkaline brown soil (terra fusca), renzina, lepto- and regosols, calcareous gley (both Estonia). As geological underground is documented limestone, argillites (Italy), pleistocenic sands (e.g. Poland). The grain size ranges from sand to clay and the extent of the litter layer from absent to rather thick (e.g. forests).

indicator value

The species is a good indicator for poorly manured grasslands on nitrogen-poor soils.

synanthropy

In respect of synanthropy the species possesses a wide range, from natural to distinct anthropogenic.

occurrence of fruitbodies

The basidiocarps are produced from early summer till late autumn (June - November), in Italy still in December.

threats

In the European scale the fungus is critically endangered (?). It is mainly threatened by intensification or termination of grassland management and by eutrophication of sites (e.g. due to nitrogen deposits from air pollution).

status of conservation

The species is red listed in Austria, Czech Republic, Denmark, France, Germany, Hungary, Italy (preliminary list), Lithuania, Luxembourg, Norway, **Poland**, Slovakia, **Spain**, Sweden, Switzerland, The Netherlands, and UK. The fungus is protected by law in Croatia and Lithuania.

14. Faerberia carbonaria (Alb. & Schwein.: Fr.) Pouzar

geography

global distribution: Europe, Africa (Canary Islands), North America (USA)

distribution in Europe: ## The species occurs from the lowlands to mountainous regions (in Italy also above 1200 msm).

areal diagnosis for Europe: ##

frequency

number of current known sites: about 200 (?)

centres of abundance: **Finland?**, **France?**, Germany, Italy, **Poland?**, **Sweden?**

changes in frequency: For Denmark and France a decrease has been noticed for the last 2 decades, for the Netherlands a slight decrease is reported since 1960. There is no record for Romania after 1975. For Czech Republic and Poland no changes of frequency were announced.

substratum

The fungus lives saprobic on old firesites (carbonicolous), mainly on man made ones after clearcutting. The species is decaying burnt wood from coniferous (e.g. Czech Republic, Poland) as well as from deciduous trees (records e.g. from Slovenia, Sweden, UK). In Serbia the species was found around a burnt beech stump.

habitat

vegetation: The fungus is specialized on old firesites normally still free from seed plant vegetation, but often more or less covered by mosses (e.g. *Barbula* spp., *Funaria hygrometrica*). The firesites can be located within forests as well as outside. The following vegetation types are reported: deciduous forests (e.g. *Castanea*, *Quercus* spp. [Italy], *Castanea* [Hungary], *Fagus* [Serbia]), sclerophyllous forests (*Quercus ilex*, *Qu. suber* [Italy]), and coniferous forests (e.g. *Picea* [Germany]). Suitable biotopes are also forest roads, places at rail roads, gardens and cemeteries.

syntaxa of vegetation: Relevant for the fungus seems only *Funarietum hygrometricae* (Germany)

soil requirements: Probably the soil characters below the layer of burnt wood and ash are not of importance for the occurrence of the fungus (data e.g. for granite, limestone [Spain], sand [The

Netherlands], for acid and basic soils). The reports reveal a colonization of dry as well as of rather wet places. The nitrogen content is reported as moderate high.

indicator value

The species is a very good indicator for old firesites.

synanthropy

The species is indifferent regarding synanthropy. Natural habitats as coniferous forests (fire because of thunderbolt) as well as strong anthropogenic ones (e.g. cemeteries [Germany]) are suitable for the fungus.

occurrence of fruitbodies

In regions with cold winters the basidiocarps are produced from early summer till late autumn (May - November), in regions with mild winters (e.g. South-France, Italy) fruitbodies can be found nearly all over the year.

threats

In the European scale the fungus is not endangered (?). In a few countries (e.g. Denmark, France, Germany) there is a decrease of the fungi because of lower activities in burning wood (regional burning is prohibited due to fire hazard and air pollution).

status of conservation

The species is red listed in Austria, Czech Republic, Denmark, France, and The Netherlands (in Poland only in regional red lists). The species is protected by law in Slovenia.

15. Geoglossum atropurpureum (Batsch: Fr.) Pers.

geography

global distribution: Europe, **North Africa (Canary Islands ?, where in Macaronesia ?)**, North America (USA)

distribution in Europe: ## The species exclusively occurs in the lowlands (up to 500 msm).

areal diagnosis for Europe: ##

frequency

number of current known sites: about 150

centres of abundance: mainly Sweden, partly Denmark, Finland, France, and UK

changes in frequency: For Denmark a decrease has been noticed for the last 3 decades, for Sweden for the last 6 decades. There is no record for Russia after 1902. For Finland and France no changes of frequency were announced. For UK even an increase of sites is reported (**due to an increase of field research?**).

substratum

The species lives saprobic terricolous colonizing often mossy and grassy soils.

habitat

vegetation: The fungus mainly inhabits extensively used meadows and pastures, but it also was found in coastal grasslands and dunes (e.g. UK), at mossy banks and in clear felling areas (Germany). For

Spain the occurrence in evergreen *Quercus* forests is reported, for France in shrub vegetations (e.g. *Buxus* stands). In Finland the species was found in forests with grasses and herbs, in The Netherlands in deciduous forests.

syntaxa of vegetation: *Nardetea strictae*, *Galio saxatilis-Festucion filiformis*, *Prunetalia* pp., *Calluno-Ulicetea minoris* (all France)

Natura 2000 habitats: Fixed coastal dunes with herbaceous vegetation (code 2130, Denmark, Germany, UK), Dry sand heaths with *Calluna* and *Genista* (code 2310, Germany), European dry heaths (code 4030, France), Semi-natural dry grasslands and scubland facies on calcareous substrates (code 6210, Denmark, Estonia, Finland, Sweden), Species-rich *Nardus* grasslands on siliceous substrates in mountain areas (code 6230, Denmark, Estonia, Finland, France, Sweden, UK), *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (code 6410, UK), Lowland hay meadows (code 6510, Sweden), Mountain hay meadows (code 6520, country?), Fennoscandian wooded meadows (code 6530, Finland, Sweden), Semi-natural tall herb humid meadows (code 7210, Switzerland, UK), *Quercus suber* forests (code 9330, Spain)

soil requirements: The fungus inhabits dry, fresh as well as rather wet soils (grain size sandy to clayey). The pH-value differs from basic to acid, the nitrogen content has to be low (types brown soil, calcareous soil, podzol). The litter layer has to be absent or thin.

indicator value

The species indicates more or less open and nitrogen-poor sites.

synanthropy

The species is restricted to near natural (e.g. dunes, forests) and semi-natural habitats (e.g. grasslands).

occurrence of fruitbodies

The ascocarps are mainly produced from summer till autumn (July – October), in France and UK still in December.

threats

In the European scale the fungus is vulnerable (?). The sites are mainly threatened by intensification of use and by eutrophication.

status of conservation

The species is red listed in Denmark, Finland, France, Germany, Norway, Spain, Sweden, Switzerland, and The Netherlands. About 50 percent of all current known sites are located in Sweden. That's why this country has a particular responsibility for the maintenance of this species in Europe.

16. *Gomphus clavatus* (Pers.: Fr.) Gray

geography

global distribution: Europe, Asia (Siberia), North America (USA)

distribution in Europe: ## The species occurs in Western, Eastern and Northern Europe in the lowlands, but in Southern and Central Europe mainly in mountainous regions (e.g. in Romania and Spain above 1200 msm, in Bulgaria up to 1600 msm).

areal diagnosis for Europe: ##

frequency

number of current known sites: about 500 (?)

centres of abundance: mainly France and Sweden, partly Austria, Germany, Italy, and Spain

changes in frequency: For Austria, Denmark, Germany, Hungary, Lithuania, Poland, Slovenia, and Sweden a decrease has been noticed for the last 2 - 6 decades. There is no record for Lithuania after 1974, and no for UK after 1927. For Estonia, Finland, France and Slovakia no changes of frequency were announced. For Latvia even an increase of sites is reported (due to an increase of field research?).

symbiont

The fungus lives in ectomycorrhiza with deciduous (*Fagus sylvatica*, **debatable are records for *Quercus robur* from Lithuania, *Quercus ilex* from Spain, and for *Quercus* and *Carpinus* from Czech Republic**) and coniferous trees (*Abies alba*, *Picea abies*, and *Pinus sylvestris* [e.g. Sweden], *pinaster* [Portugal, Spain], **pinea ? [Portugal]**).

habitat

vegetation: The fungus inhabits different kinds of natural and near natural forests where its symbiosis partners are present. Reports exist for beech forests, fir beech forests, spruce fir forests, alvar spruce forests of the *Calamagrostis arundinacea* type (Estonia), springy spruce forests with grasses and herbs (Finland), pine forests, mountainous coniferous forests (*Abies*, *Picea*, *Larix* [Italy]), lichen rich and subalpine forests (e.g. *Picea* [Montenegro, Serbia]) and mixed forests. From Portugal the fungus is reported for coastal pine dunes, from Spain for Mediterranean pine forests.

syntaxa of vegetation: *Abieto-Fagetum* (Bulgaria and Germany), *Vaccinio-Piceion* (Bulgaria, Germany, and Lithuania), *Fagion sylvaticae* (Bulgaria and France), *Eu-Fagenion*, *Scillo lilio-hyacinthi-Fagenion* (both France), *Carici-Fagetum*, *Hordelymo-Fagetum* (both Germany), *Luzulo nemorosae-Fagetum sylvaticae* (Hungary), *Fagetum carpaticum* (Poland), *Querco-Piceetum*, *Querco-Pinetum* (both Lithuania), *Piceetum excelsae croaticum* (Montenegro), *Soldanello majori-Piceetum* (Romania).

Natura 2000 habitats: Wooded dunes with *Pinus pinea* and/or *Pinus pinaster* (code 2270, Portugal), Western taiga (code 9010, Estonia, Finland, Latvia, Lithuania, Sweden), Fennoscandian herb-rich forests with *Picea abies* (code 9050, Estonia, Finland, Lithuania, Sweden), *Luzulo-Fagetum* beech forests (code 9110, Czech Republic, Denmark, Luxembourg, **Spain**), Atlantic acidophilous beech forests with *Ilex* (code 9120, Denmark), *Asperulo-Fagetum* beech forests (code 9130, Austria, France, Germany, UK), Medio-European subalpine beech forests (code 9140, Switzerland), Medio-European limestone beech (code 9150, **Bulgaria**, Czech Republic, Germany, Slovenia, Sweden), *Quercus ilex* forests (code 9340, Spain), Acidophilous *Picea* forests of the montane to **alpine** levels (code 9410, Bulgaria, Poland, Romania, Slovenia, Switzerland), Mediterranean pine forests with endemic mesogean *Pinus* (code 9540, Spain)

soil requirements: The species mainly occurs on distinct basic soils (but often superficially acidified by litter decomposition), seldom also on strong acid soils (types brown soil, calcareous sand and clay, marl, *rendzina*, **podzol [Portugal]**, geological underground often limestone [e.g. Slovakia], but e.g. also mineral-rich silicate bedrocks as granite and crystalline schists [e.g. Bulgaria], **pleistocenic sand [Portugal]**). The nitrogen content must be low. In respect of the grain size and the extent of litter layer no clear preferences could be revealed (e.g. in Finland mull soils with thick litter layer were recorded).

indicator value

The fungus indicates natural and near-natural forests and prefers in Southern and Central Europe mountainous regions.

synanthropy

The species avoids habitats distinctly influenced by man.

occurrence of fruitbodies

The basidiocarps are mainly produced from early summer to late autumn (June – November).

threats

In the European scale the fungus is vulnerable (?). Sites are mainly threatened by silvicultural intensification (e.g. fertilization, clear felling). Also acidification and eutrophication by immissions are considered as a severe threat.

status of conservation

The species is red listed in Austria, Bulgaria, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Latvia, Lithuania, Luxembourg, Montenegro, Norway, Poland, Serbia, Slovakia, Spain, Sweden, and UK. It is protected by law in Germany, Hungary, Lithuania, Serbia, Slovakia, and Slovenia. About 50 percent of all current known sites are located in France. That's why this country has a particular responsibility for the maintenance of this species in Europe.

17. Hapalopilus croceus (Pers.: Fr.) Donk

geography

global distribution: Europe, Asia (Siberia, Japan, Indonesia), North America (USA)

distribution in Europe: ## The species mainly occurs in the lowlands, only exceptionally in mountainous regions (in Greece and Spain also above 1200 msm, in Armenia up to 1700 msm).

areal diagnosis for Europe: ##

frequency

number of current known sites: about 100

centres of abundance: mainly Sweden, partly Germany

changes in frequency: For Armenia, France, Germany, and Sweden a decrease has been noticed for the last decades. There is no record for Romania after 1937. For Czech Republic, Estonia and Greece no changes of frequency were announced, **for Poland even an increase over a period of 30 years (due to an increase of field research?)**.

substratum

The species lives lignicolous, probably primarily as a weak parasite (perthobiont) and secondarily saprobic. It inhabits the trunk or thick branches of old living trees, causing a white rot and survives after tree death on standing and lying trunks and stumps for many years. Almost always oak wood is colonized (*Quercus cerris* [Bulgaria], *petraea*, *robur*, *rubra* [Germany]). Rarely the fungus was found on *Castanea sativa* (e.g. Armenia, Hungary, Italy), *Fagus sylvatica* (France, Greece), and *Picea abies* (Greece, also Romania?). Associated fungi are e.g. *Fistulina hepatica*, *Ganoderma resinaceum*, *Inonotus dryadeus*, *Laetiporus sulphureus*, and *Xylobolus frustulatus*.

habitat

vegetation: The species mainly occurs in thermophilous deciduous forests with old oaks, e.g. in alluvial forests, at warm forest edges, but also at dams of ponds (Czech Republic), in mixed forests (Romania), wooded meadows with oaks (Estonia, Latvia), road sides, and in parks (e.g. Finland, Latvia, Slovenia). In Greece even natural beech forests, in Greece and Romania natural spruce forests were colonized.

syntaxa of vegetation: Quercetalia roboris (France), Carpinion betuli (France, Germany, Hungary, Poland), Tilio-Carpinetum (Poland), Quercetum cerridis (Bulgaria, Hungary), Tilio-Quercetum (Lithuania), Genisto tinctoriae Quercenion robori-petraeae, Ulmenion minoris, Querco-Ulmetum minoris (all Germany), Hieracio rotundati-Piceetum (Romania)

Natura 2000 habitats: Fennoscandian hemiboreal natural old broad-leaved deciduous forests (code 9020, Estonia, Lithuania, Sweden), Fennoscandian wooded pastures (code 9070, Sweden), Luzulo-Fagetum beech forests (code 9110, France), Atlantic acidophilous beech forests with Ilex (code 9120, France), Asperulo-Fagetum beech forests (code 9130, France), Medio-European **subalpine** beech woods with Acer and Rumex arifolius (code 9140, Romania), Sub-Atlantic and Medio-European oak or oak-hornbeam forests of the Carpinion betulae (code 9160, Denmark, France, Germany, Poland, Sweden, Switzerland), Galio-Carpinetum oak-hornbeam forests (code 9170, France), Tilio-Acerion forests of slopes, screes and ravines (code 9180, Latvia), Old acidophilous oak woods with Quercus robur on sandy plains (code 9190, France, Slovenia), Galicio-Portuguese oak woods with Quercus robur and Quercus pyrenaica (code 9230, Portugal), Castanea sativa woods (code 9260, Italy, **Latvia?**), Mixed ash-alder alluvial forests (code 91EO, Czech Republic, Latvia), Ridarian mixed forests (code 91FO, Croatia, Czech Republic, Germany), Pannonic woods with Quercus petraea and Carpinus betulus (code 91GO, Croatia)

soil requirements: Because the species is lignicolous soil characters should be without relevance (reported are sand, brown soil, grey soil, vega, and limestone).

indicator value

The species is a rather good indicator for thermophilous forests and woods with old oaks.

synanthropy

The species is mainly restricted to natural and near-natural forests, occasionally it was found in anthropogenic biotopes (e.g. parks).

occurrence of fruitbodies

The basidiocarps are mainly produced from early summer till late autumn (May - November), in Portugal still in December.

threats

In the European scale the fungus is critically endangered (?). It is mainly threatened by felling of old oak trees and by silvicultural intensification in general.

status of conservation

The species is red listed in Armenia, Austria, Czech Republic, Denmark, Estonia, France, Germany, Latvia, Lithuania, Norway, Poland, **Serbia**, Slovakia, Sweden, and Switzerland (**also red listed for UK but there without reliable records**). It is protected by law in Croatia, Estonia, Latvia, Lithuania, and Slovakia. More than 50 percent of all current known sites are located in Latvia and Sweden. That's why these countries have a particular responsibility for the maintenance of this species in Europe.

18. Haploporus odorus (Sommerf.: Fr.) Bondartsev & Singer

geography

global distribution: Europe, Asia (Siberia), North America (USA)

distribution in Europe: **##** The species mainly occurs in the lowlands, only exceptionally in mountainous regions (in Sweden above 500 msm, in Armenia even above 1200 msm).

areal diagnosis for Europe: ##

frequency

number of current known sites: about 1500

remark: There is no reliable record of the species for Poland (but cited for Poland by Ryvarden & Gilbertson 1993).

centres of abundance: mainly Sweden, partly Finland

changes in frequency: For Armenia and Sweden a decrease has been noticed for the last 3 decades. For Finland no changes of frequency were announced.

substratum

It is a lignicolous fungus always living on old and tall willows (only *Salix caprea*?, **no information on the species for Armenia and Russia**). Accordingly, the fungus is extremely specialized and stenoeccious.

habitat

vegetation: The species is restricted to boreal and (rarely) mountainous more or less wet habitats with old willows. Suitable sites are e.g. moist depressions in spruce dominated old-growth forests, and undisturbed old stands along brooks.

syntaxa of vegetation:

Natura 2000 habitats: Western taiga (code 9010, Finland, Sweden), Fennoscandian herb-rich forests with *Picea abies* (code 9050, Finland, Sweden), Bog woodland (code 91DO, Finland)

soil requirements: Because the species is lignicolous soil characters should be without relevance. According to the ecological preferences of *Salix caprea* the soils of the sites are more or less wet and not too poor in nutrients.

indicator value

The species indicates old stands of tall willows at more or less wet places.

synanthropy

The species is restricted to natural and near-natural habitats.

occurrence of fruitbodies

The basidiocarps are perennial and therefore can be found all over the year.

threats

In Europe the fungus has a strong limited distribution and is critically endangered (?). It is mainly threatened by felling old willows and by silvicultural intensification in general.

status of conservation

The species is red listed in Armenia, Finland, Norway, Sweden, and regional red listed in Russia. It is protected by law in Sweden.

Nearly 90 percent of all current known sites are located in Sweden. That's why this country has a particular responsibility for the maintenance of this species in Europe.

19. *Helvella atra* König: Fr. ss. Holmskj.

remark: According to the finish report not clearly restricted from *Helvella subglabra* and *H. pezizoides*.

geography

global distribution: Europe, North America (USA)

distribution in Europe: ## The species mainly occurs in the lowlands, only occasionally in mountainous regions (e.g. in Macedonia, Slovenia and Spain up to 1200 msm, in Armenia, Bulgaria and Switzerland also above).

areal diagnosis for Europe: ##

frequency

number of current known sites: about 500 (?)

centres of abundance: France?, Czech Republic, Germany

changes in frequency: For Estonia a decrease has been noticed for the last 3 decades. For Austria, Czech Republic, Finland, France, Greece, Iceland, and Spain no changes of frequency were announced.

substratum

The fungus mainly lives saprobic terricolous often at mossy places decaying humus particles. Very rarely the species was found on strong decayed woody material (e.g. wood shreds).

habitat

vegetation: The fungus inhabits a very wide range of habitats, forests and plantations as well as different kinds of more or less open biotopes. Suitable forests are first of all deciduous ones, e.g. beech, oak, and alder forests, alluvial forests, but also mixed and coniferous forests are colonized, e.g. forests on dunes (France), pine forests, montane fir beech forests, evergreen Mediterranean forests (both Croatia). The occurrence of the fungus in bushes, shrublands, grassy heathlands (Iceland), macchia (Italy), and grasslands (including lawns) is also recorded. Rather often the species also was found in anthropogenic habitats such as recultivated coal mining dumps (e.g. Czech Republic), road sides, ruderal sites (Finland), cemeteries, gardens, and parks (e.g. Lithuania, in Serbia also with Cupressus).

syntaxa of vegetation: *Tilio-Fraxinetum*, *Vaccinio-Piceetum* (both Bulgaria), *Carpinion betuli*, *Galio sylvatici-Carpinetum*, *Fagion sylvaticae*, *Hordelymo-Fagetum*, *Carici-Fagetum*, *Betulo-Quercetum petraeae*, *Pruno-Fraxinetum*, *Ulmenion minoris*, *Quercu-Ulmetum minoris*, *Salicetum cinereae* (all Germany), *Carici pilosae-Carpinetum*, *Asperulo-Fagetum* (both Hungary), *Tilio cordatae-Carpinetum betuli*, *Stellario holostaeae-Carpinetum betuli*, *Galio odorati-Fagetum* (all Poland), *Symphyto cordati-Fagetum* (Romania), *Betulo-Adenostyletea*, *Salicion waldsteinianae* (both Switzerland)

Natura 2000 habitats:

soil requirements: Most often the fungus was found on more or less basic and nutrient rich soils, but also the occurrence on distinct acid and rather nutrient poor soils is proved. The following soil types were reported: andosols (Iceland), alvar soils (Estonia), grey forest soils (Bulgaria), brown soil, podzol (Romania), ranker, vega; geological underground: e.g. granite, limestone). The grain size ranges from sand to clay and the extent of the litter layer from absent to rather thick. The fungus only avoids very wet and peaty soils.

indicator value

In the European range the fungus has to be considered as euryoecious and without a distinct indicator value (but regional it can be indicate specific habitats and ecological conditions).

synanthropy

The species occurs in natural, semi-natural as well as in strong anthropogenic habitats (e.g. cemeteries, gardens).

occurrence of fruitbodies

In temperate regions the ascocarps are produced from early summer till late autumn (May - November). In the Mediterranean the period of fructification is prolonged, e.g. in Spain from January till December.

threats

In the European scale the fungus is not endangered (?), but e.g. silvicultural intensification would reduce the number of sites.

status of conservation

The species is red listed in Armenia, Austria, France, Germany, Hungary, Poland, and The Netherlands (in Spain only regional red listed).

20. *Hericium erinaceus* (Bull.: Fr.) Pers.

remark: Also in Europe the species is cultivated as medicinal mushroom. The cultivation leads to an increase of sites in gardens. Furthermore, a genetic introgression between the cultivated strains and the native populations is to be assumed.

geography

global distribution: Europe, Asia (Turkey, Japan), North America (USA)

distribution in Europe: ## The species mainly occurs in the lowlands, only seldom in mountainous regions (e.g. Greece, Macedonia, in Armenia up to 1400 msm, in Italy up to 1500 msm).

areal diagnosis for Europe: ##

frequency

number of current known sites: about 350

centres of abundance: France, Germany, Spain, The Netherlands, UK

changes in frequency: In Denmark a decrease has been noticed for the last 100 years, in France, Greece, Hungary, and Sweden for the last decades. For Romania there is no record after 1975. For Armenia and Czech Republic no changes were reported, for UK even an increase of sites (due to an increase of field research?).

substratum

Primarily, the species lives as perthobiont (necrotrophic) on living old deciduous and sclerophyllous trees. Through lesions it invades the wood of trunks and thick branches and causes a white rot. After the dead of the trees the fungus is able to continue its growth for many years and to produce fruitbodies also on lying trunks and stumps. Mainly *Fagus sylvatica* and *Quercus* spp. (*cerris*, *frainetto*, *gussonei*, *ilex*, *leptobalana*, *petraea*, *pubescens*, *robur*) are colonized, seldom also *Aesculus hippocastanum* (Germany), *Albizia julibrissin* (Greece), *Alnus glutinosa* (Ukraine), *A. incana*

(Romania), *Carpinus betulus* (Germany), *Populus tremula* (Ukraine) and *Tilia cordata* (Germany). A characteristic associated fungus is *Creolophus cirratus*.

habitat

vegetation: The fungus mainly occurs in deciduous and sclerophyllous forests, most often in beech and oak forests, but also in oak plantations, semi-open forests, maple ash forests, and coniferous plantations with deciduous trees. There are some records for habitats influenced by man (especially road sides and parks, e.g. Armenia, Denmark, Greece, Spain, Ukraine). In The Netherlands the fungus was exclusively found in such anthropogenic habitats. For Germany (?) there is even a record for wood in a mine.

syntaxa of vegetation: *Querco-Fagetea* probably except *Quercetalia pubescenti-sessiliflorae* (France), *Fagion sylvaticae* (e.g. Bulgaria), *Luzulo-Fagetum* (both Germany and Poland), *Galio odorati-Fagenion*, *Galio odorati-Fagetum*, *Hordelymo-Fagetum*, *Carici-Fagetum*, *Luzulo-Fagenion*, *Potentillo albae-Quercetum petraeae* (all Germany), *Quercetum cerridis* (Bulgaria), *Quercetum frainetto-cerris*, *Festuco heterophyllae-Fagetum* (both Macedonia), *Melittio-Fagetum* (Hungary), *Fagetum carpaticum* (Poland), *Carpino-Fagetum*, *Carpino-Quercetum* (both Romania)

Natura 2000 habitats: Fennoscandian hemiboreal natural old broad-leaved deciduous forests (code 9020, Sweden), Fennoscandian wooded pastures (code 9070, Sweden), *Luzulo-Fagetum* beech forests (code 9110, Austria, Czech Republic, Denmark, France, Germany, Luxembourg, Poland, Sweden), Atlantic acidophilous beech forests with *Ilex* (code 9120, France, Germany, Spain, UK), *Asperulo-Fagetum* beech forests (code 9130, Czech Republic, Denmark, France, Germany, Spain, Sweden, UK), Medio-European **subalpine** beech woods with *Acer* and *Rumex arifolius* (9140, Czech Republic, FranceRomania), Medio-European limestone beech forests (code 9150, Denmark, France, Germany), Sub-Atlantic and Medio-European oak or oak-hornbeam forests of the *Carpinus betulae* (code 9160, France, Germany, Slovenia, Sweden, Switzerland, **UK? is Eu-Atlantic**), *Galio-Carpinetum* oak-hornbeam forests (code 9170, Austria, France), *Tilio-Acerion* forests of slopes, screens and ravines (code 9180, **Germany**, UK), Old acidophilous oak woods (code 9190, France), *Galicio-Portuguese* oak woods with *Quercus robur* and *Quercus pyrenaica* (code 9230, Portugal), *Quercus faginea* and *Quercus canariensis* Iberian woods (code 9240, Portugal, Spain), *Quercus suber* forests (code 9330, Spain), *Quercus ilex* forests (code 9340, Italy, Spain), Pannonic woods with *Quercus petraea* and *Carpinus betulus* (code 91GO, Croatia)

soil requirements: Because the species is lignicolous soil characters should be without relevance. Reported is a wide range of soil types and characters.

indicator value

The species is a rather good indicator for old-growth beech and oak forests.

synanthropy

The species is mainly restricted to natural and near-natural forests (rather seldom at road sides and in parks).

occurrence of fruitbodies

The basidiocarps are mainly produced from early summer till late autumn (August - November), in UK even till December – January, in Greece also from March till May.

threats

In the European scale the fungus is vulnerable (?). Sites are mainly threatened by silvicultural intensification, mainly by felling of old trees.

status of conservation

The species is red listed in Armenia, Austria, Bulgaria, Czech Republic, Denmark, France, Germany, Hungary, Luxembourg, Macedonia, Poland, Serbia, Slovakia, Sweden, The Netherlands, and UK (**in**

Spain only regional red listed). It is protected by law in Croatia, Hungary, Poland, Serbia, Slovenia, and UK.

21. *Hohenbuehelia culmicola* M. Bon

geography

global distribution: not known outside Europe, but possibly also in the Asian steppe zone.

distribution in Europe: ## The species is restricted to coastal dunes and steppe-like vegetation and therefore to the lowlands.

areal diagnosis for Europe: ##

frequency

number of current known sites: about 40

centres of abundance: France, The Netherlands, UK

changes in frequency: For France, and The Netherlands no changes were reported, for UK even an increase of sites (due to an increase of field research?).

substratum

The species mainly inhabits the basal part of stems, the rhizoms and probably also fleshy roots of *Ammophila arenaria*, seldom it was found on other grasses (*Koeleria glauca* [Denmark], near *Festuca* and *Stipa* [Hungary]). It is considered to live as saprobiont from dead material but at the beginning of plant tissue colonization also a parasitic mode of nutrition seems likely (for Denmark also reported from living plants).

habitat

vegetation: The fungus nearly exclusively inhabits coastal dunes, first of all white dunes as the typical habitat of *Ammophila arenaria*. Less often fixed dunes (gray dunes) as a later successional stage at shorelines are colonized by the fungus (UK). In Hungary it was found in a steppe-like vegetation.

syntaxa of vegetation: *Ammophilion arenariae* (e.g. France, Germany), *Festucetum vaginatae* (Hungary)

Natura 2000 habitats: Shifting dunes along the shoreline with *Ammophila arenaria* (code 2120, Belgium, Denmark, France, Germany, Italy, Republic of Ireland, UK), Fixed coastal dunes with herbaceous vegetation (code 2130, UK)

soil requirements: The occurrence of the fungus is dependent on the presence of the host species. In all cases the soils were distinct sandy, well drained, aired, and rather poor in nutrients and humus (litter layer absent or thin). The pH-value was mainly basic to neutral, seldom also acid (The Netherlands).

indicator value

The species is a good indicator for undisturbed or only weakly influenced coastal dunes.

synanthropy

The species is restricted to natural and near-natural dunes and steppe-like vegetation.

occurrence of fruitbodies

The basidiocarps are mainly produced late in the year (October - December), in euoceanic regions still in January - April.

threats

In the European scale the fungus is critically endangered (?). It is mainly threatened by disturbance of sandy coasts by recreation facilities and by coastal management.

status of conservation

The species is red listed in Denmark, France, The Netherlands, and UK.

22. Hydnellum suaveolens (Scop.: Fr.) P. Karst.

geography

global distribution: Europe, Asia (Siberia, symbiosis e.g. with *Abies sibirica*), North America (Canada, USA)

distribution in Europe: ## The species occurs from the lowlands (mainly Scandinavia) to mountainous regions (e.g. in Austria, Montenegro above 1200 msm, in Italy also above 1800 msm).

areal diagnosis for Europe: ##

frequency

number of current known sites: about 500

centres of abundance: mainly Finland and Sweden, partly also Germany and Italy

changes in frequency: For Czech Republic, Germany, Lithuania, Poland, and Sweden a decrease is reported for the last 4 - 7 decades. In Finland no changes have been noticed.

symbiont

The species lives ectomycorrhizal and most often in symbiosis with *Picea abies*, occasionally also with *Abies alba* in the mountains and with *Pinus sylvestris* in more continental regions (e.g. Czech Republic, Lithuania, Romania). **A record on a symbiosis with *Quercus pubescens* (Ukraine) is categorized as debatable.**

habitat

vegetation: The fungus mainly occurs in spruce forests, in Central Europe particularly in montane ones (e.g. in Estonia spruce forests of the *Oxalis acetosella* type) but only seldom in spruce plantations. Records also exist for mixed forests with beech, fir forests, subalpine larch forests, and for unimproved grasslands near forest edges.

syntaxa of vegetation: Vaccinio-Piceetea, Vaccinio-Piceetum (both Germany), Vaccinio-Piceion (Bulgaria, Poland), Piceetum excelsae croaticum (Montenegro), Piceetum montanum, Abieti-Fagetum (both Romania)

Natura 2000 habitats: ##

soil requirements: The fungus inhabits acid, neutral and more or less basic soils (but often superficially acidified by litter decomposition) with a good water supply (types: e.g. brown soil, podzol; geological underground: basalt [Germany], granite, limestone, schists [Bulgaria]). The nitrogen content ranges from low to medium, the extent of the litter layer is variable.

indicator value

The fungus is characteristic for natural and near-natural fir forests.

synanthropy

The species avoids tree plantations distinctly influenced by man.

occurrence of fruitbodies

The basidiocarps are produced from early summer to late autumn (June – November).

threats

In the European scale the fungus is endangered (?). Sites are mainly threatened by silvicultural intensification.

status of conservation

The species is red listed in Bulgaria, Czech Republic, France, Germany, Montenegro, Poland, and Sweden.

About 80 percent of all current known sites are located in Finland and Sweden. That's why these countries have a particular responsibility for the maintenance of this species in Europe.

23. *Hygrocybe calyptriformis* (Berk. & Broome) Fayod

geography

global distribution: Europe, Asia (Japan), North America (USA)

distribution in Europe: ## The species occurs from the lowlands to subalpine regions (e.g. Slovenia, UK).

areal diagnosis for Europe: ##

frequency

number of current known sites: about 300 or 600 (?), in UK appr. 250 or 500 ?

centres of abundance: mainly UK, partly France, Germany

changes in frequency: For Czech Republic, France, Germany, and Slovakia a decrease has been noticed for the last decades, for Lithuania no records after 1974. For Poland no changes of frequency were announced. For UK even an increase of sites is reported (due to an increase of field research?).

substratum

The species lives saprobic terricolous by decomposing humus particles (also in forests from grassy and herbaceous species?).

habitat

vegetation: The fungus is recorded from different kinds of biotopes. Most often it was found in extensively used unfertilised grasslands (meadows and pastures). The species also occurs in dunes, forests (e.g. alder, ash, and beech forests, sclerophyllous forests), grazed open forests (dehesas), oak plantation (Ukraine), olive-tree plantation (Italy), calcareous fens, heaths, and shrublands. Noteworthy is a certain preference for anthropogenic biotopes especially in UK (lawns, churchyards, cemeteries, and parks).

syntaxa of vegetation: forests: Corylo-Fraxinetales (France), Alnetum incanae (Poland), coppices: Prunetalia p.p. (France), heaths: Genistion pilosae (France), Nardo-Callunetum (Hungary), grasslands: Festuco-Brometea, Ononidion striatae, Festuco-Seslerietea (all France), Polygalo-Nardetum, Astrantio-Trisetetum flavescens, Geranio-Trisetetum, Meo-Festucetum rubrae (all Germany), Festuceto rubrae-Agrostidetum, Viola caninae-Nardetum (Romania)

Natura 2000 habitats: Fixed coastal dunes with herbaceous vegetation (code 2130, France), Wooded dunes with Pinus pinea and/or Pinus pinaster (code 2270, Portugal), Siliceous alpine and boreal grasslands (code 6150, UK), Alpine and subalpine calcareous grasslands (code 6170, France, Slovenia, UK), Semi-natural dry grasslands and scrublands facies on calcareous substrates (code 6210, Croatia, France, Republic of Ireland, Serbia, Switzerland, UK), Species-rich Nardus grasslands on siliceous substrates in mountain areas (code 6230, Germany, Republic of Ireland, Switzerland, UK), Dehesas with evergreen Quercus spp. (code 6310, Portugal), Calcareous fens with Carex lasiocarpa (code 6410, Czech Republic, UK), Lowland hay meadows (Code 6510, UK), Mountain hay meadows (code 6520, Croatia, Germany, Poland, Romania, UK), Medio-European limestone beech forests (code 9150, Denmark), Galicio-Portuguese oak woods with Quercus robur and Quercus pyrenaica (code 9230 or 9240, Spain), Cupressus forests (code 9290, Portugal), Machair (code 21AO, Republic of Ireland)

soil requirements: Regarding soil characters the fungus is euryoecious. It tolerates a wide range of pH-values, from acid to basic, of water supply from rather dry to damp, and a nitrogen content from low to moderate high. The following soil types and geological undergrounds are reported brown soil, rendzina (Germany); limestone (e.g. Slovenia), crystalline schists (Bulgaria). The fungus avoids sandy soils and sites with a thick litter layer.

indicator value

The fungus indicates more or less open biotopes, often rich in plant species and rather poor in nutrients.

synanthropy

The species mainly occurs in semi-natural and distinct anthropogenic grasslands, seldom in natural biotopes (e.g. forests, dunes).

occurrence of fruitbodies

The basidiocarps are mainly produced from summer till autumn (June - November), in UK still in December.

threats

In the European scale the fungus is endangered (?). It is mainly threatened by intensification or termination of grassland management and by eutrophication of sites (e.g. due to nitrogen deposits from air pollution).

status of conservation

The species is red listed in Austria, Czech Republic, Denmark, France, Germany, Hungary, Italy (**preliminary list**), Poland, Slovakia, **Spain?**, Switzerland, and UK. It is protected by law in Croatia, Hungary, and UK.

By far the majority of current known sites is located in UK. That's why this country has a particular responsibility for the maintenance of this species in Europe.

24. *Hygrocybe laeta* (Pers.: Fr.) P. Kumm.

Synonym: *Gliophorus laetus* (Pers.: Fr.) Herink (or *Hygrocybe laeta* synonym?)

geography

global distribution: Europe, Asia (Siberia, Corea, Japan, New Guinea, Malaysia), Africa (Atlas Mountains), America (Canada, USA, Costa Rica, Chile)

distribution in Europe: ## The species mainly occurs in the lowlands, occasionally also in mountainous regions (e.g. Spain, in Bulgaria and France also above 1200 msm).

areal diagnosis for Europe: ##

frequency

number of current known sites: about 500 (?)

centres of abundance: Finland, France, Germany, Sweden (?), UK

changes in frequency: For Czech Republic, France, Germany, and The Netherlands a decrease has been noticed for the last decades (but for The Netherlands also an increase in dune areas since 1990). For Finland, Hungary, and Slovenia no changes of frequency were announced.

substratum

The fungus lives as a terricolous saprobe and decays humus particles and litter (also *Picea* needles, Iceland). It occurs rather often between mosses.

habitat

vegetation: The species was found in a very wide range of habitats. The majority of the records derives from extensively used unfertilised meadows and pastures, seldom it occurs in grasslands with higher nutrient amount. The fungus is also reported for different kinds of deciduous forests, coniferous forests and plantations (e.g. *Cryptomeria japonica* [Croatia], *Pinus nigra* [Hungary]), mixed forests, edges of forests, heaths, white and grey dunes, fens and bogs. In Iceland the fungus was found in grassy snow beds and in spruce woodlands. Only rather seldom the species occurs in gardens and cemeteries (mainly UK).

syntaxa of vegetation: forests: *Carpinion betuli*, *Quercion pubescenti-petraeae*, *Vaccinio uliginosi-Betuletum pubescentis*, *Dicrano-Pinion*, *Leucobryo-Pinetum* (all Germany), *Quercetum petraeae-cerris*, *Luzulo-Quercetum* (both Hungary), coppices: *Roso-Juniperetum*, *Calluno-Sarothamnetum*, heaths: *Nardo-Callunetea* (The Netherlands), grasslands: *Ammophiletea arenariae*, *Corynephorion canescentis*, *Nardion*, *Polygalo-Nardetum*, *Nardetum alpigenum*, *Thymo-Festucetum*, *Violion caninae*, *Juncion squarrosi*, *Arrhenatherion elatioris*, *Geranio-Trisetetum*, *Festuco-Cynosuretum*, *Lolio-Cynosuretum*, *Junco-Molinietum caeruleae* (all Germany), *Nardo-Callunetum* (Hungary), *Juncetum squarrosi*, *Festuco-Galietum veri*, *Thero-Airion* (The Netherlands), *Festuco rubrae-Agrostetum tenuis* (Romania)

Natura 2000 habitats: ##

soil requirements:

The species prefers more or less acid and nutrient-poor soils, but tolerates even basic and eutrophic ones. The soil moisture ranges from distinct wet to rather dry. As soil types are recorded brown soil, pseudogley, ranker, regosol, and peaty soils, as geological underground e.g. granite (Bulgaria), limestone (Slovenia), quartz, sandstone, and schists (e.g. Czech Republic). The extent of the litter layer is reported as thin, clay is the dominant grain size.

indicator value

The fungus mainly indicates open vegetation types on more or less acid and nutrient-poor soils.

synanthropy

The species mainly occurs in natural and semi-natural habitats (e.g. forests, grasslands), only rather seldom in anthropogenic biotopes.

occurrence of fruitbodies

The basidiocarps are mainly produced from summer till late autumn (July - November), in UK still in December.

threats

In the European scale the fungus is endangered (?). It is mainly threatened by intensification or termination of grassland management and by eutrophication of sites (e.g. due to nitrogen deposits from air pollution).

status of conservation

The species is red listed in Czech Republic, France, Germany, Hungary, and The Netherlands.

25. *Hygrophorus marzuolus* (Fr.: Fr.) Bres.

geography

global distribution: Europe, Africa (Atlas Mountains, symbiosis with *Cedrus atlantica*), North America (USA)

distribution in Europe: ## The species mainly occurs in mountainous regions (e.g. in Austria, Macedonia, and Serbia also above 1200 msm), seldom in the lowlands (e.g. Spain).

areal diagnosis for Europe: ##

frequency

number of current known sites: about 250 (?)

centres of abundance: France (?), Germany, partly Italy, Slovenia

changes in frequency: For Austria, Czech Republic, Germany, Macedonia, and Slovakia a decrease has been noticed for the last decades For France, and Spain no changes of frequency were announced.

symbiont

The fungus mainly forms ectomycorrhiza with coniferous trees of the family Pinaceae, most often with *Abies* (*alba*, *borisii-regis* [Macedonia]) and *Picea*, but also with *Pinus* (*mugo* incl. *uncinata*, *nigra*, *sylvestris*) and *Pseudotsuga* (France). Only relatively seldom the fungus was found in symbiosis with Fagaceae, especially *Fagus sylvatica*, in Southern Europe moreover *Castanea sativa*, *Quercus cerris*, and *Qu. petraea*.

habitat

vegetation: The species mainly inhabits montane fir and spruce forests, seldom also coniferous plantations, mixed and deciduous forests as beech and oak forests. The fungus is assigned as related to the *Clitocybe brumali-Phellodonetum nigri* (Czech Republic).

syntaxa of vegetation: *Galio odorati-Fagetum*, *Carici-Fagetum*, *Galio rotundifolii-Abietenion*, *Piceion abietis* (all Germany), *Piceo-Pinetum sylvestris*, *Piceetum excelsae croaticum* (both Montenegro),

Dicrano-Pinetum silvestris, Piceo-Fagetum (both Romania), Digitali viridiflorae-Pinetum peuces (Macedonia)

Natura 2000 habitats: ##

soil requirements: The fungus mainly colonises more or less basic (but often superficially acidified by litter decomposition) to neutral soils. Reported are brown soil, podzol (e.g. Romania), and rendzina (geological underground e.g. granite [Macedonia], marble, schists [both Bulgaria], limestone). The moisture of the soils ranges from rather dry to wet, the grain size from sand to clay, and the extent of the litter layer from absent to thick. The fungus avoids strong acid (pH-value below 3,5) and eutrophic soils.

indicator value

The species indicates not too strong acidified forests, in Central Europe mainly montane ones.

synanthropy

The fungus nearly exclusively occurs in natural and near-natural forests (seldom in plantations).

occurrence of fruitbodies

In the typical case the fruitbodies are clustered and appear in early spring sometimes already when the forest floor is still covered with snow (often February - March, in higher mountains and in cold springs also April - May, in the Mediterranean also from December onwards). **For Serbia a period from June till October was reported (?).** The intensity of fructification is fluctuating strongly over the years (masses of fruit bodies in some years and no fructifications in many others [**due to different weather conditions?**]).

threats

In the European scale the fungus is vulnerable (?). Sites are mainly threatened by silvicultural intensification (e.g. clear felling, planting of allochthonous trees, fertilization), but also by strong acidification due to air pollution.

status of conservation

The species is red listed in Austria, Czech Republic, France, Germany, Hungary, Macedonia (preliminary list), Montenegro, Serbia, and Slovakia. It is protected by law in Croatia, Germany, Serbia, and Slovakia. **In the past the species was sold on markets in Austria, France, Germany, Italy, and Switzerland (nowadays this is prohibited).**

26. Hygrophorus purpurascens (Alb. & Schwein.: Fr.) Fr.

geography

global distribution: Europe, Africa (Atlas Mountains, var. cedretorum Maire in symbiosis with Cedrus atlantica), Asia (Japan, **Southeast Asia?, see Bern Convention sheet**), North America (USA)

distribution in Europe: ## The species occurs from the lowlands to mountainous regions (in France also above 1200 msm).

areal diagnosis for Europe: ##

frequency

number of current known sites: about 40

centres of abundance: mainly Norway and Sweden, partly France and Switzerland

changes in frequency: For Czech Republic and Sweden a decrease has been noticed (last record in Czech Republic 1966). For Finland even an increase of sites is reported (due to an increase of field research?).

symbiont

The fungus nearly exclusively lives in ectomycorrhiza with *Picea abies*, very seldom with *Abies alba* (France, Romania; also with *Pinus* France?, eventually also Sweden).

habitat

vegetation: The species is restricted to spruce forests (e.g. in Finland with grasses and herbs), wooded pastures with spruce, and mixed forests with fir (also pine forests?).

syntaxa of vegetation: *Erico carnea*-*Pinetea sylvestris*, *Fagion sylvaticae* p.p. (both France), *Abieti-Fagetum* (Romania)

Natura 2000 habitats: Western taiga (code 9010, Finland, Sweden), Fennoscandian herb-rich forests with *Picea abies* (code 9050, Finland), Fennoscandian wooded pastures (code 9070, Sweden), *Asperulo-Fagetum* beech forests (code 9130, France)?, *Galicio-Portuguese oak woods with Quercus robur and Quercus pyrenaica*?(code 9230 or 9240, Portugal), Acidophilous *Picea* forests of the montane to alpine levels (code 9410, Romania, Slovenia, Switzerland), *Alpine Larix decidua and/or Pinus cembra* forests (code 9420, country?), *Subalpine and montane Pinus uncinata* forests?(code 9430, France)

soil requirements: The species prefers mesotrophic damp soils and avoids distinct nutrient-poor and strong acid ones. The occurrence on brown soil, basic soils, marl (Germany), and podzol (Finland) was recorded.

indicator value

The fungus is a rather good indicator for spruce forests not too nutrient-poor and acidified.

synanthropy

The species mainly occurs in natural and near-natural habitats (forests), occasionally in semi-natural (pastures).

occurrence of fruitbodies

The basidiocarps are produced in autumn (August – September).

threats

In the European scale the fungus is critically endangered (?). Sites are mainly threatened by silvicultural intensification (e.g. clear felling, planting of allochthonous trees), but also by strong acidification due to air pollution.

status of conservation

The species is red listed in Czech Republic, Finland, France, Germany, Norway, Sweden, Switzerland, and The Netherlands. More than 50 percent of current known sites are located in Norway and Sweden. That's why these countries have a particular responsibility for the maintenance of this species in Europe.

27. *Hymenochaete cruenta* (Pers.: Fr.) Donk

geography

global distribution: Europe, Asia (Turkey, Siberia), Australia (whether autochthonous?)

distribution in Europe: ## The species mainly occurs in mountainous regions (above 1200 msl e.g. in Romania, Russia, Serbia), only exceptionally in the lowlands and uplands (e.g. Russia, The Netherlands).

areal diagnosis for Europe: ##

frequency

number of current known sites: about 100 (?)

centres of abundance: France, Germany, Switzerland (?)

changes in frequency: In France and Germany a decrease has been noticed for the last decades. For Romania there is no record after 1975, for UK no record after 1960 (?). For Czech Republic, Poland, and The Netherlands no changes of frequency were announced.

substratum

It is a lignicolous fungus living primarily as a weak parasite (perthobiont) on corticated branches and trunks, in most cases of ailing trees of *Abies alba*, secondary saprobiontic on dead substrata. **In more Eastern regions of Europe also other species of Pinaceae are colonised. In Romania and Serbia the fungus was found on *Picea excelsa*, in Ukraine on a living trunk of *Pinus* (only one record?). For Turkey there is a debatable record for *Quercus*.** Because the fungus often occurs on standing trees in a height of 10 to 30 metres in the crowns it is classified as aerobiont. On fallen branches the fruitbodies die quickly.

habitat

vegetation: The fungus mainly inhabits montane mixed beech spruce fir forests. In Central Europe it occurs especially at places with high humidity (e.g. Northern slopes), in The Netherlands and UK only in fir plantations (because *Abies* is not native there). From **Romania and Serbia the species is also reported for spruce forests, from Ukraine for an oak pine forest (where in Turkey?).**

syntaxa of vegetation: *Vaccinio-Piceetum* (Bulgaria), *Galio odorati-Fagion* (Germany), *Abieti-Fagetum* (Germany, Romania), *Piceetum excelsae croaticum* (Montenegro), *Dentario glandulosae-Fagetum*, *Dentario enneaphylli-Fagetum*, *Galio-Abietetum*, *Abietetum polonicum*, *Abieti-Piceetum montanum*, *Bazzanio-Piceetum*, *Quercu-Piceetum* (all Poland), *Abieti-Fagetum dinaricum* (Slovenia)

Natura 2000 habitats: ##

soil requirements: Because the fungus is lignicolous soil characters should be without relevance. According to the ecological preferences of *Abies alba* such soils are not strongly acidified but well water supplied.

indicator value

The species is a good indicator for montane forests with *Abies alba*.

synanthropy

The species is mainly restricted to natural and near-natural forests (very seldom in plantations).

occurrence of fruitbodies

The basidiocarps can be found all over the year. Spores are produced during periods of high precipitation and humidity.

threats

In the European scale the fungus is critically endangered (?). Sites are mainly threatened by silvicultural intensification (e.g. clear felling, planting of allochthonous trees), but also by strong air pollution because *Abies alba* is sensitive against immissions.

status of conservation

The species is red listed in Austria, Czech Republic, France, Germany, Poland, and The Netherlands. By far the majority of sites is located in the Alps. That's why the Alpine countries have a particular responsibility for the maintenance of this species in Europe.

28. *Laccaria maritima* (Theodor.) Singer ex Huhtinen

geography

global distribution: Europe, North America (Canada, USA), also Asia ?

distribution in Europe: ## The species exclusively occurs in the lowlands, most often near the coast lines.

areal diagnosis for Europe: ##

frequency

number of current known sites: about 50 (?). Surely the species was often overlooked because of its small fruitbodies and its similarity with other *Laccaria* species.

centres of abundance: The species is very scattered distributed. In respect of countries there are no centres discernable.

changes in frequency: For Estonia, Finland, France, and The Netherlands no changes of frequency were announced.

symbiont

As the other species of the genus *Laccaria* the fungus forms ectomycorrhiza, definitely with *Salix* (*daphnoides*, *repens*, what else?), probably also with *Pinus sylvestris* (Finland, Sweden). Debatable is a trophic association with *Ammophila arenaria* (Denmark).

habitat

vegetation: The fungus is limited to open sandy sites. The majority of records derives from coastal white, grey and brown dunes (in Italy dunes with *Juniperus macrocarpa* and *J. phoenicea*), but the species also was found on inland dunes (Estonia, Poland) and at sandy shores of seas and rivers (Finland).

syntaxa of vegetation: Elymo-Ammophiletum, Helichryso-Jasionetum (both Poland)

Natura 2000 habitats: Shifting dunes along the shoreline with *Ammophila arenaria* (code 2120, Denmark, Finland, Germany, Poland, Sweden, The Netherlands, UK?)

soil requirements: The fungus always inhabits distinct sandy soils (types initial stages of postglacial sands and podzol [Poland], in Iceland also on blackish volcanic sand). The soils are rather dry to more or less wet and acidic. The nutrient content is distinct low to moderate low, a litter layer is absent.

indicator value

The fungus is a very good indicator for open sandy sites poor in nutrients.

synanthropy

The species is restricted to natural and near-natural habitats and that's why to be considered as anthropophobic.

occurrence of fruitbodies

The basidiocarps are mainly produced from summer till autumn (August - October), in Poland still in December.

threats

In the European scale the fungus is vulnerable (?) because of its specific requirement of sandy nutrient poor sites with initial vegetation. This type of vegetation is rare in Europe and e.g. threatened by nitrogen deposits from air pollution.

status of conservation

The species is red listed in Sweden and The Netherlands.

29. *Laricifomes officinalis* (Vill.: Fr.) Kotl. & Pouzar

geography

global distribution: Europe, Asia (Turkey, Siberia, Russian Far East), North America (USA)

distribution in Europe: ## The species mainly occurs in high mountainous and subalpine regions, only exceptionally in the lowlands and uplands (Germany, Lithuania, Poland, and Russia).

areal diagnosis for Europe: ##

frequency

number of current known sites: about 80

centres of abundance: France, Switzerland

changes in frequency: In France, Poland, Slovakia, and Slovenia a decrease has been noticed for the last 50 to 100 years. For Lithuania there is no record after 1968.

substratum

The species is a weak parasite (perthobiont) and colonises nearly exclusively very old trees of *Larix decidua* (in Poland *L. decidua* ssp. *polonica*). In Turkey the fungus was found on *Cedrus libani* (?). The fruitbodies are developed at bark lesions of the trunk.

habitat

vegetation: The species is very characteristic for virgin subalpine larch forests. Exceptionally the fungus was found on planted *Larix* trees outside the Alpes and Sudetes, e.g. in Lithuania in a city park (where in Turkey?).

syntaxa of vegetation: *Rhododendro-Vaccinion*, *Juniperion nanae* (both France), *Quercu robori-Pinetum* (Poland), *Seslerio rigidae-Pinetum sylvestris*, *Saxifrago cuneifoliae-Laricetum* (both Romania)

Natura 2000 habitats: Subpannonic steppic grasslands (code 6240, Austria)?, Asperulo-Fagetum beech forests (code 9130, Romania)?, Medio-European subalpine beech woods with Larix decidua (code 9140, Romania), Alpine Larix decidua-Pinus cembra forests (code 9420, France, Germany, Italy, Slovenia, Switzerland), Montane Pinus sylvestris forests (code 9430, Romania)

soil requirements: Because the fungus is lignicolous soil characters should be without relevance. The host Larix decidua prefers base-rich soils (e.g. renzina) in high mountainous and subalpine regions.

indicator value

The species is a good indicator for old mainly undisturbed subalpine Larix forests.

synanthropy

Almost exclusively the fungus occurs in natural forests (very seldom in plantations).

occurrence of fruitbodies

The basidiocarps are perennial and that`why can be found all over the year.

threats

In the European scale the fungus is critically endangered (?). Sites are mainly threatened by cutting of old Larix trees and by logging of subalpine forests (e.g. to construct facilities for winter sport). In some regions the fruitbodies are collected and used as traditional medicine.

status of conservation

The species is red listed in Austria, France, Germany, Lithuania, Poland, Slovakia, and Switzerland. The fungus is protected by law in Germany, Lithuania, Poland, and Slovenia. About 80 percent of current known sites are located in France and Switzerland. That`s why these countries have a particular responsibility for the maintenance of this species in Europe.

30. Leucopaxillus compactus (Fr.) Neuhoff

geography

global distribution: Europe, Africa (Canary Islands), North America (USA)

distribution in Europe: ## The species mainly occurs in the lowlands, occasionally also in lower mountainous regions (e.g. Austria, Bulgaria, Romania, Slovenia), never found above 1200 msm.

areal diagnosis for Europe: ##

frequency

number of current known sites: about 150

centres of abundance: France, Germany, partly Spain, Switzerland

changes in frequency: For France, Hungary, Lithuania, and Slovenia a decrease has been noticed for the last 2 - 5 decades. For Estonia there is no record after 1984. For Austria and Slovakia no changes of frequency were announced.

substratum

The fungus is a terricolous saprobiont and decays leaf litter and humus particles of woody plants, possibly also from herbaceous.

habitat

vegetation: The fungus mainly occurs in forests, most often in different kinds of deciduous, e.g. beech, oak hornbeam, alluvial forests, Sub-Mediterranean forests (e.g. with *Carpinus orientalis* [Croatia]), dry grassy oak forests, but also in sclerophyllous (*Quercus ilex*, *rotundifolia*, *suber* [e.g. Italy]), and mixed forests (e.g. *Castanea*, *Fagus*, *Picea*, *Pinus* [Slovenia]), very seldom even in coniferous forests (*Cupressus sempervirens* [Italy]). Only rather seldom the species was found in deciduous plantations, in dry grasslands near forest edges (e.g. Germany), in wooded dunes (e.g. Hungary), wooded grasslands (Estonia) and in wooded pastures respectively (e.g. Finland). Typical associated fungi in beech forests are e.g. *Boletus appendiculatus*, *B. impolitus*, and *Russula foetens*.

syntaxa of vegetation: forests: *Quercetum pubescentis* (Bulgaria), *Querco-Carpinetum* (Czech Republic, Romania), *Rubio-Fagetum*, *Aceri monspessulani-Fagetum*, *Rusco-Quercetum petraeae*, *Viburno lantanae-Quercetum petraeae*, *Quercetalia pubescenti-sessiliflorae*, *Quercetalia ilicis* (all France), *Carpinion*, *Cephalanthero-Fagenion* (both France, Germany), *Galio odorati-Fagenion*, *Galio odorati-Fagetum*, *Hordelymo-Fagetum*, *Carici-Fagetum*, *Galio sylvatici-Carpinetum*, *Ulmenion minoris*, *Querco-Ulmetum minoris* (all Germany), *Erico-Quercetum cerridis*, *Cytiso-Quercetum pubescentis* (both Italy), *Tilio-Quercetum* (Lithuania), *Tilio cordatae-Carpinetum betuli* (Poland); wooded grasslands or grasslands near forests edges: *Festuco Brometea*, *Mesobromion erecti*, *Xerobromion*, *Mesobrometum*, *Pulsatillo-Caricetum humilis* (all Germany)

Natura 2000 habitats: Wooded dunes of the atlantic, continental and boreal region (code 2180, France), Fennoscandian wooded meadows (code 6530, Estonia), Fennoscandian hemiboreal natural old broad-leaved deciduous forests (code 9020, Estonia, Latvia, Lithuania, Sweden), Fennoscandian wooded pastures (code 9070, Finland, Sweden), *Luzulo-Fagetum* beech forests (code 9110, Slovenia), *Asperula-Fagetum* beech forests (code 9130, Germany, Sweden, Switzerland), Medio-European subalpine beech forests (code 9140, Switzerland), Medio-European limestone beech forests (code 9150, Denmark, France), Sub-Atlantic and Medio-European oak or oak-hornbeam forests of the *Carpinion betulae* (code 9160, Germany), Old acidophilous oak woods with *Quercus robur* on sandy plains (code 9190, Romania), *Castanea sativa* woods (code 9260, Croatia), *Quercus ilex* and *Q. rotundifolia* forests (code 9340, France, Italy), Euro-Siberian steppe oak woods (code 9110, Czech Republic), Pannonic woods with *Quercus petraea* and *Carpinus betulus* (code 91GO, Croatia)

soil requirements: The species prefers mesotrophic basic to neutral soils, only exceptionally it was found on distinct acid ones (Hungary, Romania). The majority of records derives from rather dry sites, but the fungus is also recorded from wet (e.g. Estonia, Spain). It was found on different kinds of soils (e.g. cambisols, luvisols and regosols [all Estonia], loess [Czech Republic], renzina, brown soil, podzol [e.g. Romania]; geological underground e.g. limestone, sandstone, phyllites). The grain size ranges from sand to clay, mostly a litter layer is present.

indicator value

In the European scale the fungus is rather euryoecious and therefore doesn't indicate specific ecological conditions.

synanthropy

The fungus mainly inhabits natural and near-natural forests, occasionally also semi-natural biotopes (plantations, grasslands).

occurrence of fruitbodies

The basidiocarps are produced from summer till late autumn (July - November).

threats

In the European scale the fungus is vulnerable. It is mainly threatened by silvicultural activities damaging the sites (first of all by clear felling).

status of conservation

The species is red listed in Bulgaria, Czech Republic, Denmark, Finland, France, Germany, Hungary, Lithuania, Norway, Spain, and Sweden (in Poland only regional red listed). The fungus is protected by law in Croatia, Latvia, Lithuania, and Slovenia.

31. *Lyophyllum favrei* R. Haller Aar. & R. Haller Suhr

geography

global distribution: Europe, Asia (Caucasus)

distribution in Europe: ## The species only occurs in the uplands and in submountainous regions (350 - 600 msm, **height in Ukraine?**).

areal diagnosis for Europe: ##

frequency

number of current known sites: about 25

centres of abundance: Switzerland

changes in frequency: For France no changes of frequency were announced, **for the other countries the situation is insufficiently known (?)**.

substratum

The species lives terricolous saprobiontic and decays leaf litter and humus particles of deciduous trees.

habitat

vegetation: The fungus is restricted to deciduous forests. Most often mesophilic forests with beech are colonised, sometimes also wet **but not temporarily flooded (?)** forests in river valleys.

syntaxa of vegetation: Carpinion, Fagion, Alno-Ulmenalia minoris (all France)

Natura 2000 habitats: Asperula-Fagetum beech forests (code 9130, France, Switzerland, UK), Alluvial forests with Alnus and Fraxinus (code 91EO, France), Ridarian mixed forests (code 91FO, Switzerland)

soil requirements: The fungus colonises more or less neutral, fresh to wet mesotrophic to rather eutrophic clayey soils (brown soil, alluvial soil). A litter layer is **always well developed (?)**.

indicator value

The species is stenoecious and indicates deciduous forests on rather nutrient rich soils with a good water supply.

synanthropy

The fungus always inhabits natural and near-natural forests.

occurrence of fruitbodies

The basidiocarps are produced in autumn (September - October).

threats

In the European scale as well as worldwide the fungus is critically endangered. The sites are mainly threatened by silvicultural intensification (e.g. clear felling, planting of allochthonous trees).

status of conservation

The species is red listed in France, Switzerland, and UK. More than 50 percent of current known sites are located in Switzerland. That's why this countries has a particular responsibility for the maintenance of this species in Europe and worldwide.

32. *Montagnea radiosa* (Pallas) Šebek

remark: In Europe occurs only the variety *radiosa*.

geography

global distribution for *Montagnea radiosa* var. *radiosa*: Europe, Africa (Canary Islands, North Africa), Asia (Middle East, Central Asia), North, Central and South America

distribution in Europe:

The fungus mainly occurs in the lowlands, seldom also in lower mountainous regions (Spain), only in Armenia found above 1200 msm.

areal diagnosis for Europe: ##

frequency

number of current known sites: about 50 (?)

centres of abundance: Spain, probably also Ukraine and Russia

changes in frequency: For Armenia and Slovakia a decrease is reported for the last decades (no record for Slovakia after 1987). In Hungary, Poland, Spain no changes have been noticed.

substratum

The fungus lives terricolous saprobic and decays dead plant material (if rhizomes and roots of *Poaceae*?).

habitat

vegetation: The fungus inhabits dry and more or less sandy places, e.g. coastal (Malta, Spain) and inland dunes (e.g. Hungary, Slovakia), xerothermic pastures (Poland, Slovakia), steppe-like vegetation with *Stipa* on slopes with Southern exposure (Germany, Poland). In more continental Europe it occurs in steppes (Armenia, Austria, Ukraine) and steppe meadows (Ukraine, among *Festuca valesiaca*). Very seldom it was found in more or less anthropogenic habitats as *Robinia* plantation (Poland), recultivated ash area (Czech Republic) and wayside (Ukraine).

syntaxa of vegetation: dunes: *Cakiletea*, *Ammophiletea* (Malta), grasslands: *Festuco-Stipetum* (Germany), *Festucetum vaginatae* (Hungary), *Cirsio-Brachypodium pinnati* (Poland), *Ceratocarpo-Euphorbion stepposae* (Romania), *Festucion valesiaca* (Slovakia)

Natura 2000 habitats: Pannonic sand steppes (code 6260, Hungary, Ukraine?, there is the pontic steppe), Shifting dunes along the shoreline with *Ammophila arenaria* (code 2120, Malta, Spain?)

soil requirements: The species mainly colonises distinct sandy, neutral to slight basic dry soils, from Spain it is also recorded for wet soils (types: alluvial sands, loess [e.g. Austria], brown soil [Poland], cernoziomic soils [Romania], ash [Czech Republic]). The nitrogen content seems to be low to moderate, a litter layer is absent or thin.

indicator value

It is a thermophilic fungus and characteristic for dry and warm grassy habitats.

synanthropy

The species inhabits a wide range of biotopes, natural and near-natural (dunes, steppes), semi-natural (grasslands) and very seldom also habitats considerably influenced by man.

occurrence of fruitbodies

The basidiocarps are produced from early summer till autumn (May - October).

threats

Probably, in the European scale the fungus is not endangered. Sites are mainly threatened by intensification or termination of grassland management, eutrophication and afforestation.

status of conservation

The species is red listed in Armenia, Austria, Czech Republic, Germany, Hungary, Malta, Poland, Slovakia, and Spain,

33. *Myriostoma coliforme* (With: Pers.) Corda

geography

global distribution: Europe, Asia (Middle East, Central Asia, Himalaya), Africa (North, East and South), North and South America, Oceania (Hawaii)

distribution in Europe:

The species mainly occurs in the lowlands, occasionally also in lower mountainous regions (e.g. Croatia, Italy, Romania), in Armenia still found in a height of 2000 msm.

areal diagnosis for Europe: ##

frequency

number of current known sites: about 150

centres of abundance: France, Spain, The Netherlands

changes in frequency: There are no indications for strong and large-area frequency changes. A decrease of the species is reported from France, Poland and The Netherlands (slight) for the last 5 decades. **There is no record for UK after 1896 (?)**. In Greece, Macedonia, Serbia, and Spain no changes have been noticed. For Hungary and Slovakia even an increase of sites is reported.

substratum

It is a terricolous saprobic fungus decaying leaf litter and other organic material.

habitat

vegetation: The species occurs in open as well as in wooded biotopes. It colonises grassy habitats, e.g. pastures, xerophytic grasslands (e.g. Austria, Bulgaria), steppes (Ukraine) and coastal dunes (The Netherlands, UK), and different kinds of woodlands, frequently in deciduous (there often the nitrogen accumulating Robinia [e.g. Romania, Serbia, Slovakia], moreover e.g. Castanea [Italy], Populus, Ulmus [Ukraine]), in Greece e.g. in alluvial forests, also in sclerophyllous forests, scrubs and macchia (Paliurus spina-christi [Bulgaria], Quercus ilex [Italy]), in mixed forests (Quercus ilex and Abies

borisii-regis [Greece]), and coniferous woodlands (Italy). Rather many records derives from anthropogenic habitats (e.g. nitrophilous coppices [e.g. France, Germany, Poland], ruderal vegetation [Hungary], roadsides [e.g. Croatia, Slovakia], hedges, gardens [Greece, UK], arboretum [Ukraine]).

syntaxa of vegetation: Ulmenion minoris, Populenalia albae, Onopordetalia acanthii, Carthametalia lanati (all France), Querco-Carpinetum orientalis, Juniperetum excelsae (both Macedonia), Carpino-Fagetum, Bromo sterili-Robinetum pseudoacaciae (both Romania)

Natura 2000 habitats: Fixed coastal dunes with herbaceous vegetation (code 2130, UK), Atlantic decalcified fixed dunes (code 2150, UK), Dunes with Salix repens (code 2170, UK), Coastal dune with Juniperus spp. (code 2250, Portugal, UK), Inland dunes with open Corynephorus and Agrostis grasslands (code 2330, Romania), Dry Atlantic coastal heaths (code 4040, UK), Pannonic sand steppes (code 6260, **country?**), Calcareous and calcshist screes of the montane to alpine levels (code 8120, **country?**), Calcareous rocky slopes with chasmophytic vegetation (code 8210, Sweden), Siliceous rocky slopes with chasmophytic vegetation (code 8220, Sweden, Switzerland), Luzulo-Fagetum beech forests (code 9110, Austria), Galio-Carpinetum oak hornbeam forests (code 9170, Austria), Castanea sativa woods (code 9260, Italy), Quercus ilex and Q. rotundifolia forests (code 9340, Croatia, Italy), Riparian mixed forests along the great rivers (code 91FO, France), Salix alba and Populus alba galleries (code 92AO, France, Italy).

soil requirements: The fungus inhabits often sandy, more or less basic soils, seldom on clayey (Bulgaria, Greece) and acidic ones (Spain). Noteworthy is the preference of the fungus for rather eutrophic and nitrogen-rich sites (**from Macedonia reported for nitrogen-poor soils ?**). In humid areas the soils are distinct dry, but in semiarid regions comparatively damp to wet.

The extent of litter layer ranges from thin to thick. The grain size is always large, from gravel [Slovakia] to sand (types e.g. brown soil [Bulgaria], loess; geological underground: e.g. limestone, granite [Bulgaria]).

indicator value

In humid areas the fungus indicates sunny dry places well supplied with nutrients.

synanthropy

Especially in temperate Europe the fungus rather often occurs in anthropogenic nutrient-rich habitats.

occurrence of fruitbodies

Because the basidiocarps are rather persistent they can be found and identified all over the year.

threats

In the European range the species is not endangered (?). It is rather well adapted to eutrophication and habitat disturbances. At open sites the species seems to be threatened by afforestations.

status of conservation

The species is red listed in Armenia, Austria, Bulgaria, Czech Republic, France, Germany, Hungary, Poland, Serbia, Slovakia, Spain, Sweden, Switzerland, The Netherlands, and UK (in Macedonia in a preliminary red list). It is protected by law in Croatia, Serbia, and Slovakia. About 80 percent of all current known sites are located in France, Spain and The Netherlands. That's why these countries have a particular responsibility for the maintenance of this species in Europe.

34. Panaeolus semiovatus (Sowerby: Fr.) S. Lundell & Nannf.

Synonym: Panaeolus fimiputris (Bull.: Fr.) Quél. ss. auct.

geography

global distribution: almost cosmopolitical, Europe, Asia, Africa, Australia, North and South America

distribution in Europe: ## The species mainly occurs from the lowlands to mountainous and subalpine regions, in Austria is also was found in the alpine zone up to 2500 msm.

areal diagnosis for Europe: ##

frequency

number of current known sites: about 500

centres of abundance: e.g. Finland, France, Germany, Iceland, Italy, Spain. Although excrements of herbivores are common everywhere in Europe the fungus is very rare e.g. in Denmark (2 sites), and Hungary (3 sites).

changes in frequency: For the Czech Republic, Germany, and the Western part of Poland a decrease has been noticed for the last 40 years. In the Netherlands the species was in decrease from 1950 to 1980, From this time onwards the number of sites is increasing there.

substratum

A saprobic fungus colonizing dung of domestic (cow, horse, and sheep) and wild (which species?) herbivores, **from Sweden also reported for fertile soils (dung already completely decayed or overlooked?)**.

habitat

vegetation: The fungus mainly occurs in anthropogenic grasslands (meadows, also fertilized pastures), in nutrient-poor semi-natural grasslands (e.g. The Netherlands), and in steppes (Ukraine), but is also recorded from deciduous forests (e.g. Alnus, Castanea, Quercus spp.), sclerophyllous forests (Quercus ilex), and coniferous forests because of grazing in these habitats. The species also was found in parks, along grassy roadsides, and forest roads (Bulgaria, Poland).

syntaxa of vegetation: Alnetum glutinosae, Cynodonti-Festucetum (both Hungary), Festuco-Agrostetum tenuis, Scorzonero roseae-Festucetum nigricantis (both Romania)

Natura 2000 habitats: ##

soil requirements: Because the fungus is coprophilous soil characters are mainly of importance in respect of wetness which could increase the water content of dung. The species is reported for dung above brown luvic and podzolic soils, and above sand.

indicator value

A specific indicator value is not known.

synanthropy

The species occurs in natural (e.g. Hungary, Spain, Italy, Ukraine) als well as in strong anthropogenic habitats.

occurrence of fruitbodies

The basidiocarps are mainly produced from early summer till autumn (May - October) in periods of high precipitation or in habitats with wet soils and high humidity. For France records exist from January to December.

threats

In the European scale the fungus is not endangered. Sites are threatened by agricultural intensification (e.g. pesticides), and afforestation.

status of conservation

The species is red listed in France, Germany, Hungary, Poland, and Serbia. It is protected by law in Serbia.

35. *Phylloporus pelletieri* (Lév.) Quél.

remark: In North America occurs the similar *Phylloporus rhodoxanthus* (Schwein.: Fr.) Bres. ss. str., in Japan *Phylloporus bellus* (Masse) Corner.

geography

global distribution: Europe, Asia (Middle East, e.g. Turkey)

distribution in Europe: ## The species mainly occurs from the lowlands to lower mountainous regions, only seldom in the higher mountains (e.g. Italy, Montenegro, Ukraine, in Bulgaria up to 1600 msm).

areal diagnosis for Europe: ##

frequency

number of current known sites: about 1000

centres of abundance: France, Germany, partly Belgium, Italy, Spain, Switzerland, and UK.

changes in frequency: For Poland, Sweden a decrease is reported for the last decades. In Austria, Czech Republic, Denmark, France, Slovakia, and Spain no changes have been noticed. For The Netherlands and UK even an increase of sites is reported **for the last 2 decades (due to an increase of field research?)**.

symbiont

The species forms ectomycorrhiza with deciduous (often *Fagus sylvatica* [ssp. *moesiaca* in Montenegro]), but also *Castanea sativa* [Hungary, UK], *Quercus cerris* [Hungary], *petraea*, *robur*, *rubra* [Germany], probably also *Tilia cordata* [Germany]) and coniferous trees (*Abies alba*, *Picea abies*, *Pinus sylvestris*).

habitat

vegetation: Because of its symbiotic mode of life the fungus is restricted to wooded biotopes. Most often it occurs in deciduous forests, e.g. alluvial forests, but also in mixed and coniferous forests and plantations, only seldom in nutrient-poor lichen rich pine forests (e.g. Montenegro) and wooded dunes (Germany). The species prefers for fructification forests edges and forest banks. Rarely it was found in synanthropic habitats (e.g. roadsides [The Netherlands], parks, cemeteries [Germany]).

syntaxa of vegetation: *Quercetalia roboris*, *Arbuto-Quercetum petraeae*, *Periclymeno-Quercetum petraeae*, *Sorbo torminalis-Quercetum petraeae*, *Mespilo-Quercetum petraeae*, *Hyperico montani-Quercenion robori-petraeae*, *Luzulo-Fagion*, *Stellario holosteae-Carpinetum betuli*, *Vaccinio-Piceetea p.p.*, *Pinetalia sylvestris p.p.* (all France), *Fagion sylvaticae* (Germany, Poland), *Ilici-Fagenion*, *Galio odorati-Fagetum*, *Dentario glandulosae Fagenion*, *Dentario enneaphylli-Fagetum*, *Carici-Fagetum*, *Abieti-Fagetum*, *Luzulo-Abietetum*, *Carpinion betuli*, *Genisto tinctoriae-Quercenion robori-petraeae*, *Holco mollis-Quercetum*, *Dicrano-Pinion*, *Leucobryo-Pinetum*, *Pruno-Fraxinetum* (all Germany), *Luzulo-Fagetum* (Germany, Hungary), *Melittio-Fagetum subcarpaticum*, *Luzulo-Quercetum*, *Quercu petraeae-Carpinetum pannonicum* (all Hungary), *Fagetum moesiaca montanum*, *Piceetum excelsae croaticum* (both Montenegro), *Carpino-Fagetum* (Romania)

Natura 2000 habitats: Western taiga (code 9010, Sweden), Fennoscandian hemiboreal natural old broad-leaved deciduous forests (code 9020, Sweden), Luzulo-Fagetum beech forests (code 9110, Czech Republic, France, Germany, Slovenia, Switzerland), Atlantic acidophilous beech forests with Ilex (code 9120, France), Asperulo-Fagetum beech forests (code 9130, Austria, Denmark, Germany, Luxembourg, Sweden, Switzerland), Medio-European limestone beech forests (code 9150, Denmark), Sub-Atlantic and Medio-European oak or oak-hornbeam forests of the Carpinion betulae (code 9160, France, Germany, Romania, Sweden, Switzerland, **UK? is Eu-Atlantic**), Galio-Carpinetum oak-hornbeam forests (code 9170, Czech Republic), Old acidophilous oakwoods with Quercus robur on sandy plains (code Czech Republic, Germany), Castanea sativa woods (code 9260, Croatia), Sub-Mediterranean pine forests with endemic black Pinus (code 9530, Austria, **native in Austria?**), Alluvial forests with Alnus and Fraxinus (code 91EO, Germany), Pannonic woods with Quercus petraea and Carpinus betulus (code 91GO, Croatia)

soil requirements: The fungus is moderate acidophilous (seldom on superficially acidified calcareous soils, types e.g. brown soil, nutrient-rich sandy soil, ranker [Montenegro] above e.g. limestone, sandstone, granite, and porphyry). The species avoids distinct eutrophic as well as wet sites. The grain size ranges from sand to clay, a litter layer is absent or thin.

indicator value

The species reveals vitals forests on more or less acid soils not too rich in nutrients.

synanthropy

The fungus is a good indicator for natural and near-natural forests (only seldom in distinct synanthropic wooded habitats).

occurrence of fruitbodies

The basidiocarps are mainly produced from summer till autumn (July - November), in euoceanic regions (e.g. UK) still in December.

threats

In the European scale the species is not endangered (?). Sites are mainly threatened by silvicultural intensification (e.g. clear felling and fertilisation).

status of conservation

The species is red listed in Austria, Bulgaria, Denmark, France, Germany, Hungary, Moldavia, Montenegro, Norway, Poland, Slovakia, Spain, Sweden, and The Netherlands. It is protected by law in Croatia, Hungary, Slovenia.

36. Pisolithus arhizos (Scop.: Pers.) S. Rauschert

remark: Populations of Pisolithus of the Southern Hemisphere (e.g. in mycorrhiza with Eucalyptus spp. belong to other species.

geography

global distribution: Europe, Asia (Middle East, East, and South Asia), Africa (Canary Islands, Atlas Mountains), North America (USA)

distribution in Europe: The species mainly occurs from the lowlands to lower mountainous regions (e.g. in Germany up to 700 msm), only in Italy also above 1200 msm.

areal diagnosis for Europe: ##

frequency

number of current known sites: more than 1000 (?)

centres of abundance: France, Germany, Italy, Spain, what else?

changes in frequency:

In France, Poland, Portugal, and The Netherlands no changes have been noticed. For Denmark, Hungary, and UK even an increase of sites is reported for the last 2 - 6 decades (due to an increase of field research?).

symbiont

It is an ectomycorrhizal fungus living in symbiosis with coniferous trees, *Cupressus sempervirens* (Italy), *Picea abies* (e.g. Romania, Slovenia), or *Pinus* (*halepensis* [Greece, Italy], *maritima* [Greece], *nigra*, *pinaster* [Portugal], *pinea*, *sylvestris*), with deciduous and sclerophyllous trees, *Betula pendula* (e.g. Hungary), *Populus* (Germany), *Quercus* (*cerris* [Hungary], *ilex*, *petraea*, *pubescens*, *rubra* [Germany], *suber*), in the Mediterranean also with *Cistus* (*creticus*, *salvifolius* [both Italy], *monspeulanum* [Greece]). There are debatable records for a symbiosis with *Erica arborea*, *Olea europea* (both Italy), and *Rhamnus* (Germany). Findings in *Eucalyptus* plantations (*E. camaldulensis* and *spec.*) probably belong to *Pisolithus albus* (M.C. Cooke & Masee) Priest or *P. marmoratus* (Berk.) Priest (Italy, Malta, and Portugal).

habitat

vegetation: The species inhabits a wide range of coniferous (e.g. pine forests of the *Cladonia* and *Vaccinium vitis-idaea* types [Estonia]), mixed, deciduous, and sclerophyllous forests (e.g. *Quercus ilex* and *Q. suber* forests [Italy]). It regularly also occurs in plantations most often such with pine (e.g. oak pine plantations in forest-steppes and steppes in Ukraine). As an indication for nutrient-poor and dry soils many sites are without any seed plants on the forest floor (but not seldom with mosses and lichens). Mainly in temperate Western and Central Europe the species is rather common in renaturalised brown coal mining and different other pit areas in birch pine pioneer forests (also on wooded deposits of overburden and slag). In this part of Europe the fungus is untypical for undisturbed forests with old trees. It is able to colonise also grey coastal dunes, inland dunes, and heaths with pine (e.g. Poland), furthermore *macchia*, dry grasslands and dry rocky areas (in all habitats associated with trees). Occasionally, the species was found in strong anthropogenic biotopes as ruderal places (Hungary), roadsides (e.g. Italy, UK), gardens (Germany), and parks (e.g. Poland, Slovenia).

syntaxa of vegetation: forests: *Leucobryo-Pinetum* (Germany), *Quercetum petraeae-cerris* (Hungary), *Quercetum frainetto-cerris*, *Querco-Carpinetum orientalis* (Macedonia), *Paliuretum adriaticum*, *Rusco-Carpinetum orientalis* (both Montenegro), *Soldanello majori-Piceetum* (Romania); coppices and grasslands in succession: *Calluno-Sarothamnetum*, *Corynephorion canescentis*, *Spergulo vernalis-Corynephorion canescentis*, *Violo-Corynephorion canescentis* (all Germany)

Natura 2000 habitats: ##

soil requirements: The species inhabits nutrient-poor soils (often oligotrophic), mainly distinct acid. Many records exist for sandy sites (e.g. podzol, regosol [Portugal]), but the fungus also was found on brown soil, leached cernoziomic soil (Bulgaria) and above granite (Macedonia), seldom on alkaline soils, e.g. *rendzina* above limestone (Malta, Montenegro, Slovakia). In humid regions the soils are dry, but in the Mediterranean area soils with a better water supply are colonized (because at very dry places no tree growth is possible?). The grain size ranges from gravel to clay (kaolin, Denmark). In most cases a litter layer is absent, sometimes thin.

indicator value

In many regions of Europe the species is a good indicator for nutrient-poor, acid and dry soils.

synanthropy

The species mainly occurs in forests, occasionally in plantations and in open biotopes with growing up trees. The colonised nutrient-poor soils are either natural or anthropogenic (often due to mining activities).

occurrence of fruitbodies

The basidiocarps are produced from early summer till late autumn (June - December), **in Austria already in April fresh fruitbodies, in Czech Republic already in May?** Because the basal part of the fruitbodies is rather persistent they can be found all over the year.

threats

In the European scale the fungus is not endangered (?). Sites are mainly threatened by eutrophication (mainly due to nitrogen deposits from air pollution, but e.g. also because of nutrient and litter accumulation in older forests).

status of conservation

The species is red listed in Bulgaria, Denmark, Germany, Hungary, Montenegro, Poland, and The Netherlands (in France only regional red listed). The fungus is protected by law in Croatia.

37. Podoscypha multizonata (Berk. & Br.) Pat.

geography

global distribution: Europe, Asia (Caucasus, Russian Far East)

distribution in Europe: ## The species mainly occurs in the lowlands, only seldom in mountainous regions (Spain, in Bulgaria even above 1200 msm)

areal diagnosis for Europe: ##

frequency

number of current known sites: about 120

centres of abundance: France, UK

changes in frequency:

For France a minor decrease is reported for the last 4 decades. For UK even an increase of sites was noticed (**due to an increase of field research?**).

substratum

The fungus lives lignicolous, saprobiontic on buried roots or as a weak parasite (perthobiont) at the trunk basis of living old trees. It colonises mainly *Quercus petraea* (e.g. Serbia) and *robur* (e.g. UK), rather seldom also *Fagus sylvatica* (e.g. Bulgaria, Germany).

habitat

vegetation: The fungus occurs in different biotopes with old oaks and beeches. It is reported from deciduous forests, pasture-woodlands (UK), and from parks (e.g. Germany, Slovakia).

syntaxa of vegetation: Luzulo-Fagetum (Bulgaria, Slovenia), Asperulo-Fagetum (France, Switzerland, UK), Carpinion betuli (France, Germany, UK)

Natura 2000 habitats:

Luzulo-Fagetum beech forests (code 9110, Slovenia), **Atlantic acidophilous beech forests with Ilex (code 9120, country?)**, Asperulo-Fagetum beech forests (code 9130, France, Switzerland, UK), Sub-Atlantic and Medio-European oak or oak-hornbeam forests of the Carpinion betulae (code 9160, France, Germany, **UK? is Eu-Atlantic**), Old acidophilous oak woods with Quercus robur on sandy plains (code 9190, UK)

soil requirements: Because the species is lignicolous soil characters should be without relevance, reports exist for sand, brown soil, and calcareous soil.

indicator value

The fungus indicates wooded areas with old ailing or already dead oaks and beeches.

synanthropy

The species occurs in forests, woodlands and in parks moderately influenced by man.

occurrence of fruitbodies

The basidiocarps are produced from summer till autumn (August - November). Because the fruitbodies are rather persistent the species is still identifiable in winter.

threats

In the European scale the fungus is endangered (?). It is mainly threatened by felling of old oak and beech trees and by silvicultural intensification in general.

status of conservation

The species is red listed in France Slovakia, and Spain. About 80 percent of current known sites are located in France and UK. That's why these countries have a particular responsibility for the maintenance of this species in Europe.

38. Polyporus rhizophilus Pat.

geography

global distribution: Europe, Asia (Central Asia: e.g. Kazakhstan, Mongolia), Africa (North Africa: Algeria)

distribution in Europe:

The fungus only was found in the lowlands.

areal diagnosis for Europe: ##

frequency

number of current known sites: about 50 (?), certainly widespread in the steppe zone

centres of abundance: surely Russia and Ukraine, **partly also Czech Republic and Hungary?**

changes in frequency:

For Germany and Hungary a decrease is reported for the last 3 - 5 decades. In France no changes have been noticed. For Poland even an increase of sites is reported (**due to an increase of field research?**).

substratum

The fungus belongs to the group of so-called rhizophilic Polyporus species which presumably mortify living plant tissues und decay them after death (perthobiontic mode of nutrition). Colonised are the basal parts of perennial Poaceae, leaf sheaths, culm bases, rhizoms and roots. Most often the fungus

was found on feather grasses (*Stipa* spp.), but also on *Bothriochloa ischaemum*, *Brachypodium pinnatum* (Germany), *Bromopsis riparia* (Ukraine), *Cynodon dactylon*, *Digitaria* spp., *Elymus* spp., *Elytrigia intermedia* (Czech Republic), and *Festuca* spp. (probably some more genera and species of Poaceae can be colonised).

habitat

vegetation: The species inhabits dry and warm grassy sites, mainly steppes and steppe-like grasslands. The fungus also occurs in grassy open woodlands (e.g. *Quercus ilex* forests [Spain], shelter belts in steppe reserves [Ukraine]), seldom it was found in arboreta and parks (Poland, Ukraine).

syntaxa of vegetation: grasslands: *Festucetalia valesiaca* (Czech Republic), *Mesobromion* (Germany), *Festuco valesiaca*-*Stipetum capillatae* (Germany, Poland, Romania), *Festucetum vaginatae* (Hungary), *Festuco-Brometea* (Poland)
forests: *Junipero-Populetum albae* (Hungary)

Natura 2000 habitats: Pannonic sand steppes (code 6260, Hungary, **Ukraine?, there is the pontic steppe**)

soil requirements: The inhabited soils are always distinct dry and mostly sandy, but from Poland also clayey soil is reported (types e.g. brown soil [Bulgaria], gray soil [Romania], loess [Germany]). The pH-value ranges from acid to basic (e.g. above limestone). The nitrogen content seems to be low to moderate, a litter layer is absent or thin.

indicator value

The fungus is thermophilous and characteristic for dry and warm grassy habitats.

synanthropy

The species mainly occurs in natural and semi-natural xerothermic grasslands, seldom in open woodlands with planted trees (arboreta and gardens).

occurrence of fruitbodies

The basidiocarps are produced from spring till autumn (April - November).

threats

In the European range the species is endangered (?). Sites are mainly threatened by intensification or termination of grassland management, eutrophication and afforestation.

status of conservation

The species is red listed in Austria, Czech Republic, France, Germany, Poland, and Slovakia.

39. *Poronia erici* Lohmeyer & Benkert

remark: Because the species was described only in 1988 no older data exist in the literature and the former distribution of this fungus is widely unknown.

geography

global distribution: Europe, Australia (e.g. on droppings of kangaroo, wombat), also in America? (doubtful records for Mexico)

distribution in Europe: The fungus only was found in the lowlands.

areal diagnosis for Europe: ##

frequency

number of current known sites: about 20, probably frequency is still insufficiently known

centres of abundance: France, Germany, The Netherlands

changes in frequency: For France an increase of sites is reported for the last 10 years, for the Netherlands for the last 20 years (due to an increase of field research?).

substratum

The fungus lives saprobic coprophilous and colonises dung of herbivores, mainly from rabbit, but also from donkey (Switzerland), hare (Denmark), horse (France, The Netherlands), and sheep (##).

habitat

vegetation: The species occurs in nutrient-poor grasslands, e.g. in unimproved pastures, repeatedly found in coastal grey dunes but also in inland regions.

Natura 2000 habitats: Fixed coastal dunes with herbaceous vegetation (code 2130, Denmark, Germany, The Netherlands)

soil requirements: Because it is a coprophilous species soil characters should be without high relevance. The colonised droppings were mainly found on sandy and rather dry soils.

indicator value

Probably the species indicates natural and semi-natural open biotopes not artificially fertilised and not polluted by pesticides and emissions.

synanthropy

The species is limited to natural and semi-natural grasslands.

occurrence of fruitbodies

The stromata are produced in periods of high moisture and humidity respectively, from late autumn to spring (October - May).

threats

In the European scale the fungus is endangered mainly because of its scarcity. The localities outside the dunes are threatened by agricultural intensification (e.g. by fertilisers and pesticides).

status of conservation

The species is red listed in France and Germany.

40. *Poronia punctata* (L.: Fr.) Fr.

remark: Data for *Poronia punctata* published before 1988 can include records for *Poronia erici*.

global distribution: Europe, Asia (Siberia, Central Asia: e.g. Kirgizia, Mongolia), North, Central and South America (USA, Mexico, Venezuela)

distribution in Europe: The species occurs from the lowlands to mountainous regions (in Romania also above 1200 msm).

areal diagnosis for Europe: ##

frequency

number of current known sites: about 60 (?)

centres of abundance: Spain, Sweden, UK

changes in frequency: From Denmark, Finland, France, Germany, Russia, Slovakia, and Sweden a decrease has been reported for about 100 years, from Iceland and Spain for the last 3 - 5 decades, and from The Netherlands a decrease within the period 1970 - 1990 but afterwards an increase. For Estonia there is no record after 1960, for Finland after 1948, for Poland after 1915, for Russia after 1959, and for Slovakia after 1982. **In Latvia no changes have been noticed ?.**

substratum

It is a saprobic coprophilous species colonising dung of herbivores, mainly from horse, less often from cow (historical records for Czech Republic and Germany, furthermore Russia, Ukraine), exceptionally from sheep (The Netherlands). In the past the fungus was also recorded for dung of donkey (**concrete information available?**), from Croatia for such of mule.

habitat

vegetation: The fungus only was found in grazed habitats more or less poor in nutrients, often in dry pastures, e.g. alvar meadows (Estonia), in dune areas (Finland), karstic rockfield grasslands (Croatia), in steppes (Hungary, Ukraine), but also in heaths and open woodlands (UK). It is also reported for pasturages within settlements (Ukraine).

syntaxa of vegetation: Festucetum sulcatae, Festuceto rubrae-Agrostidetum (both Romania)

Natura 2000 habitats: ##

soil requirements: Because it is a coprophilous fungus soil characters should be without high relevance. The colonised excrements were found on e.g. regosol, rendzina, brown soil, (Romania), grey forests soil and leached cernoziomic soil (both Bulgaria). In Northern areas the fungus prefers rather dry and warm soils (e.g. in Iceland only in the driest part of the island, in Sweden distinct thermophilous).

indicator value

Possibly the fungus is limited to grasslands not artificially fertilised and not polluted by pesticides and emissions.

synanthropy

The species occurs in different kinds of grassy habitats, from natural to anthropogenic.

occurrence of fruitbodies

Because the species colonises bigger dimensioned dung with a good water storage the stromata are also produced in periods with higher temperature, mainly from spring and summer till late autumn (April - November), in France, Macedonia, The Netherlands, and UK it also was found in winter.

threats

In the European scale the fungus is critically endangered (?). The sites are threatened by agricultural intensification (e.g. by using fertilisers and pesticides), possibly also by a reduction of grazing periods (at sites with stable fungal populations the animals are grazing all over the year).

status of conservation

The species is red listed in Denmark, Estonia, Finland, France and Germany, Poland, Sweden, The Netherlands, and UK (in Spain only regional red listed). About 90 percent of current known sites are

located in Spain, Sweden, and UK. That's why these countries have a particular responsibility for the maintenance of this species in Europe.

41. *Pycnoporellus alboluteus* (Ellis & Everhart) Kotl. & Pouzar

geography

global distribution: Europe, North America (USA)

distribution in Europe: ## The species occurs from the lowlands to mountainous regions (Spain, in Serbia also above 1200 msm).

areal diagnosis for Europe: ##

frequency

number of current known sites: about 25

centres of abundance: Finland, Sweden

changes in frequency:

In Finland, Poland, and Slovakia no changes have been noticed.

substratum

The species lives lignicolous saprobic on tunks and thick branches (**always lying?**). It mainly decays wood of *Picea abies*, seldom such of *Alnus incana* and *Populus tremula* (both Finland). It is reported from Scandinavia (**only Finland?**) that the fungus **always** inhabits wood pre-colonised and already more or less degraded by *Fomitopsis pinicola* (**also true in more Southern parts of Europe?**). Several times the species was found under loosened bark (Finland).

habitat

vegetation: The fungus is restricted to forests with spruce. From Finland the dominant occurrence in luxuriant *Picea abies* dominated old-growth forests is notified. From Slovakia a virgin forest is reported as habitat of the single locality.

syntaxa of vegetation: **Querco-Carpinetum (with Picea, Poland)**

Natura 2000 habitats: Western taiga (code 9010, Finland, Sweden), Fennoscandian herb-rich forests with *Picea abies* (code 9050, Finland, Sweden)

soil requirements: Because the species is lignicolous soil characters should be without relevance. According to the ecological preferences of the main host *Picea abies* the soils of the sites are wet to damp and more or less acid.

indicator value

The species is a good indicator for undisturbed spruce forests.

synanthropy

The species is restricted to forests mainly not or seldom moderate influenced by man and is to be regarded as anthropophobic.

occurrence of fruitbodies

The basidiocarps are produced from summer till autumn (July - October).

threats

In the European scale the fungus is critically endangered (?). Sites are mainly threatened by deforestation of old growth forest habitats in consequence of silvicultural intensification.

status of conservation

The species is red listed in Finland, Norway, Poland, Slovakia, and Sweden. More than 90 percent of current known sites are located in Finland and Sweden. That's why these countries have a particular responsibility for the maintenance of this species in Europe.

42. *Sarcodon fuligineoviolaceus* (Kalchbr.: Fr.) Pat.

geography

global distribution: Europe, Asia (Sakhalin island, India [Punjab], New Guinea, there symbiosis with *Castanopsis*, *Lithocarpus*), North America (USA)

distribution in Europe: ## The species occurs from the lowlands (mainly Scandinavia) to mountainous regions (in France also above 1200 msm).

areal diagnosis for Europe: ##

frequency

number of current known sites: about 50

centres of abundance: Spain and Sweden

changes in frequency:

For France a decrease is reported for the last 2 decades, for Germany and Sweden for a period of about 100 years. For Austria there is no record after 1973 (?).

symbiont

The fungus forms ectomycorrhiza exclusively with Pinaceae (*Abies alba*, *Picea abies*, and *Pinus sylvestris*).

habitat

vegetation: The inhabiting of biotopes is clearly regionally specified. In Sub-Mediterranean and temperate regions the fungus mainly occurs in pine forests on calcareous soils, e.g. in Estonia in alvar pine forests of the *Arctostaphylos uva-ursi* type. In the mountains also fir forests are suitable habitats (e.g. Austria, in France in subalpine forests) and in the boreal zone also forests with *Picea* are of importance for the fungus, in Finland in grass-herb forests with pine and/or spruce. The occurrence in dry heaths is reported from Finland as well. In Slovenia the species was found in a natural mixed forest with pine, beech, and chestnut.

syntaxa of vegetation: *Erico carneae*-*Pinetea sylvestris*, *Fagion sylvaticae* p.p. (both France)

Natura 2000 habitats: Western taiga (code 9010, Estonia, Finland, Sweden), Fennoscandian herb-rich forests with *Picea abies* (code 9050, Finland, **Slovenia?, was Sweden meant?**), Coniferous forests on, or connected to, glaciofluvial eskers (code 9060, Sweden), *Asperulo-Fagetum* beech forests (code 9130, France), Acidophilous *Picea* forest of the montane to the alpine levels (code 9410, Slovenia), Subalpine and montane *Pinus uncinata* forests (code 9430, France)

soil requirements: The species mainly inhabits calcareous soils (often superficially acidified), but occasionally also distinct acid ones (Finland, Slovenia). The sites are often dry, but especially in

Scandinavia also rather wet soils are colonised (reported types are podzol and rendzina). The nutrient content is low to moderate. Repeatedly the litter layer is recorded as thin.

indicator value

The species is characteristic for natural and near-natural habitats (mainly forests, seldom heaths).

synanthropy

The fungus never was found in strong anthropogenic biotopes.

occurrence of fruitbodies

The basidiocarps are produced from summer to autumn (August - November).

threats

In the European scale the species is critically endangered (?). Sites are mainly threatened by silvicultural intensification (especially clear felling and fertilisation) and by eutrophication due to nitrogen deposits from air pollution.

status of conservation

The species is red listed in Finland, France, Germany, Norway, Spain, and Sweden. About 50 percent of current known sites are located in Spain and Sweden. That's why these countries have a particular responsibility for the maintenance of this species in Europe.

43. Sarcosoma globosum (Schmidel: Fr.) Casp.

geography

global distribution: Europe, North America (USA)

distribution in Europe: ## The fungus occurs in Scandinavia in the lowlands, in Central Europe and in Caucasus region nearly exclusively only in the mountains (in Armenia found between 1850 and 2000 msm).

areal diagnosis for Europe: ##

frequency

number of current known sites: about 150

centres of abundance: Sweden, partly Finland

changes in frequency:

For Czech Republic, Estonia, Lithuania, and Slovakia a decrease is reported for the last 4 - 5 decades, for Germany and Sweden for the last 100 years. For Czech Republic there is no record after 1966, for Germany after ##, for Poland after 1923, and for Slovakia after 1967. For Finland and Latvia ? even an increase of sites is reported for the last decades (due to an increase of field research?).

substratum

Probably it is a humicolous saprobiontic species. With exception of the Caucasus region (?) the fungus is always associated with Picea abies colonising often mossy needle litter (from Lithuania also recorded for decayed wood among mosses). The close relation to Picea is a reason to assume an ectomycorrhizal nutrition strategy, but untypical for this is the fungal growth often on thick litter layers and the limitation to old trees. Only in Armenia the fungus was found under Sorbus (Picea overlooked?).

habitat

vegetation: The fungus nearly exclusively occurs in old spruce forests and in mixed forests with spruce. In Estonia moss-rich stands are inhabited, in Sweden also wooded pastures with spruce. **In Armenia the species was found in rather dry forests with Sorbus (also Picea?).**

syntaxa of vegetation: Piceion excelsae (Germany, Slovakia)

Natura 2000 habitats: Western taiga (code 9010, Estonia, Finland, Sweden), Fennoscandian herb-rich forests with Picea abies (code 9050, Finland, Sweden), Fennoscandian wooded pastures (code 9070, Sweden), Acidophilous Picea forest of the montane to the alpine levels (code 9410, Czech Republic)

soil requirements: The species mainly inhabits distinct acid and well water supplied soils, **only for Armenia and Finland rather dry soils are reported**. The nitrogen content is most often distinct low, from Estonia findings at mesotrophic sites were notified. The soils are sandy to silty, the only recorded type is podzol. A litter is always present and repeatedly recorded as thick.

indicator value

The species is rather stenoeious and mainly restricted to old undisturbend forests with spruce.

synanthropy

The anthropophobic fungus mainly colonises natural and near-natural biotopes (most often forests, seldom wooded pastures).

occurrence of fruitbodies

The ascocarps are mainly produced in spring and early summer (March - June), in Czech Republic and in Lithuania also found in December.

threats

In the European scale the species is critically endangered (?) and mainly threatened by deforestation of old growth forest habitats in consequence of silvicultural intensification.

status of conservation

The species is red listed in Armenia, Czech Republic, Estonia, Finland, Germany, Latvia, Lithuania, Norway, Poland, Slovakia, and Sweden (in Russia only regional red listed). The fungus is protected by law in Lithuania and Slovakia. About 80 percent of current known sites are located in Sweden. That's why this country has a particular responsibility for the maintenance of this species in Europe.

44. Sarcosphaera coronaria (Jacq.) Boud.

geography

global distribution: Europe, Asia (Middle East: Israel, Turkey), Africa (Atlas Mountains), North and Central America (Canada, USA, Mexico)

distribution in Europe: ## The fungus occurs from the lowlands to the subalpine zone (e.g. in Macedonia exclusively between 1900 and 2000 msm, in Poland mainly in the subalpine zone).

areal diagnosis for Europe: ##

frequency

number of current known sites: about 700

centres of abundance: France, Germany, Italy, Spain, Switzerland

changes in frequency:

For Czech Republic, Estonia, France, and Sweden a decrease is reported for the last 5 decades. In Austria, Croatia, Greece, Poland, and Spain no changes have been noticed. For UK even an increase of sites is reported for the last decades (due to an increase of field research?).

substratum

The mode of nutrition is not clarified yet. It is assumed but not proved that the fungus forms ectomycorrhiza (possibly only facultative). Surely the species has the potential to decompose organic material (at least by cellulases). Fruitbodies were found on humus, among leaf and needle litter, and also on decayed woody substrates (in this case the fungus is even weak lignicolous [e.g. Estonia]).

habitat

vegetation: The fungus occurs in a wide range of habitats, suitable living conditions are present in forests and plantations, in coppices up to the subalpine level as well as in open grassy biotopes. Records exist e.g. for pine and spruce forests (e.g. Slovenia), plantations of *Pinus nigra* and *P. halepensis* {Croatia, Malta}, for mixed forests (e.g. alvar forests [Estonia], *Acer*, *Fraxinus*, *Pinus* [Hungary]), for a remarkable wide range of deciduous forests, and for sclerophyllous forests, furthermore for scrublands, grey coastal dunes, and dry grasslands (both Germany). The species is assigned as related to the *Boletus aerei*-*Russuletum luteotactae* (Czech Republic).

Not seldom the fungus occurs synanthropic, in parks (e.g. Serbia), gardens, vineyards (with ectomycorrhizal trees?, Germany), at roadsides (Denmark), mining deposits, and old firesites (both Germany).

syntaxa of vegetation: forests: *Pinion sylvestris*, *Vaccinio-Piceion*, *Fagion sylvaticae* (all Bulgaria), calcareous *Dicrano-Pinion* (Finland), *Fagion sylvaticae*, *Erico carneae-Pinetea sylvestris*, *Oleo sylvestris-Ceratonion siliquae* pp., *Rhamno lycioidis-Quercion cocciferae* p.p. (all France), *Galio odorati-Fagetum*, *Hordelymo-Fagetum*, *Abieti-Fagetum*, *Lonicero alpigenae-Fagetum*, *Seslerio-Fagetum*, *Carpinion betuli* (all Germany), *Cephalanthero-Fagenion*, *Carici-Fagetum*, *Dentario enneaphylli-Fagetum* (all Germany and Poland), *Abieti-Fagetum macedonicum* (Macedonia), *Quercion ilicis* (Italy), *Dentario glandulosae-Fagetum*, *Quercus roboris-Pinetum*, *Plagiothecio-Piceetum taticum* (all Poland), *Soldanello majori-Picenion* (Romania), coppices: *Erico-Rhododendretum hirsuti*, *Roso-Juniperetum*, *Viburno-Cornetum* (all Germany), grasslands: *Gentiano-Koelerietum*, *Mesobromion erecti* (Germany)

Natura 2000 habitats:

Juniperus communis formations on heaths or calcareous grasslands (code 5130, Estonia), Semi-natural dry grasslands and scrubland facies on calcareous substrates (code 6210, Germany), Western taiga (code 9010, Finland, Romania?, was Sweden meant?), Coniferous forests on, or connected to, glaciofluvial eskers (code 9060, Finland?, in Finland 1 record in 2 habitats?), Fennoscandian wooded pastures (code 9070, Romania?, was Sweden meant?), *Asperulo-Fagetum* beech forests (code 9130, France, Germany, UK), Medio-European limestone beech forests (code 9150, Denmark, Germany, Sweden, Switzerland), *Tilio-Acerion* forests of slopes, screens and ravins (code 9180, Germany), *Castanea sativa* woods (code 9260, Italy), *Quercus ilex* forests (code 9340, Italy), Acidophilous *Picea* forest of the montane to the alpine levels (code 9410, Czech Republic, Poland, Sweden, Switzerland), Alpine *Larix decidua* and/or *Pinus cembra* forests (code 9420, Austria), Sub-Mediterranean pine forests with endemic black *Pinus* (code 9530, Croatia, France?, *Pinus nigra* not native in France!), *Quercus ilex* and *Quercus rotundifolia* forests (code 9540, Italy, Malta)

soil requirements: The majority of records originates from more or less basic and rather dry to fresh soils, but also acid soils are colonised (e.g. Hungary, Spain). The nitrogen content is low to moderate. The following soil types were reported brown soil, leptosol (Poland), loess (Czech Republic), pararendzina, rendzina, podzol (e.g. Macedonia), brown coal-rich soil (Germany), and the following geological undergrounds often limestone, seldom granite (Germany). The grain size ranges from gravel to clay, a litter layer is always present, often thick.

indicator value

The fungus possesses no specific habitat indication. Only the preference for more or less basic soils is to be mentioned.

synanthropy

The rather euryoecious fungus occurs in natural (forests), semi-natural (e.g. grasslands), and in strong anthropogenic biotopes (e.g. gardens, vineyards).

occurrence of fruitbodies

The ascocarps are mainly produced in two periods, often in spring (April - May) and occasionally in autumn (September - October), e.g. in Croatia and France already in February and in Spain still in December, in Northern regions and higher mountains mainly during the summer months (June - August, [e.g. Estonia, Finland, and Macedonia, Poland, Romania]).

threats

In the European scale the species is not endangered (?). The sites are mainly threatened by severe damages of the habitats (first of all clear felling of woodlands).

status of conservation

The species is red listed in Austria, Bulgaria, Czech Republic, Denmark, Estonia, Finland, **France (or only regional red listed ?)**, Germany, Hungary, Malta, Norway, Poland, Slovakia, Spain, Sweden, and UK. The fungus is protected by law in Estonia, Malta, and Slovakia.

45. Skeletocutis odora (Sacc.) Ginns

geography

global distribution: Europe, Asia (Siberia), North America (USA)

distribution in Europe: ## The species occurs in the lowlands as well as in mountainous regions (in Macedonia, Spain, and Ukraine above 1200 msm).

areal diagnosis for Europe: ##

frequency

number of current known sites: about 650

centres of abundance: mainly Sweden, partly Finland

changes in frequency:

From Finland a decrease is reported for the last 50 years, from Sweden for the last 100 years. In France and Poland no changes have been noticed. For Czech Republic even an increase of sites is reported for the last decades (**due to an increase of field research?**).

substratum

The species is a lignicolous saprobiont **always** (?) living on large fallen trunks. Mostly the coarse wood is moderately decayed. In Northern Europe and in mountainous regions the fungus mainly occurs on coniferous wood, most often on *Picea abies*, but also on *Pinus sylvestris* and in some cases on *Abies alba* (Croatia, Poland, Ukraine), in Macedonia even on *Abies borisii-regis*. From France a preference for deciduous trees is reported, *Quercus* and *Populus* besides *Pinus* (**but for the whole country only 5 records exist ?**), in Finland, Russia; and Southern Sweden the fungus was also notified on *Populus tremula*, in Southern Sweden on *Betula* as well. In Finland the fungus often was found

together with *Amylocystis lapponica*, *Fomitopsis rosea*, *Phellinus ferrugineofuscus*, and *Phlebia centrifuga*.

habitat

vegetation: Old growth spruce forests of the boreal and montane zone (e.g. Slovakia) are the main habitat of this fungus, but it also occurs in virgin pine (e.g. Sweden) and virgin fir forests (Poland). Sometimes the fungus was found in forests mixed with coniferous and deciduous trees (e.g. *Abies*, *Picea* and *Fagus* in Croatia). From France it is reported from old deciduous forests.

syntaxa of vegetation: **Vaccinio–Piceetea (France?, no record for *Picea* is mentioned for France)**, **Abieti-Fagetum (Macedonia)**, **Vaccinio-Piceion**, **Vaccinio-Abietion (both Poland)**,

Natura 2000 habitats: Western taiga (code 9010, Estonia, Finland, Sweden), Fennoscandian herb-rich forests with *Picea abies* (code 9050, Estonia, Finland, Sweden), **Acidophilous *Picea* forest of the montane to the alpine levels (code 9410, France) ?**

soil requirements: Because the species is lignicolous soil characters should be without relevance. According to the different host trees the range of inhabited soils is wide.

indicator value

The species is a good indicator for virgin coniferous forests and mixed forests with conifers.

synanthropy

It is an anthropophobic fungus only found in natural or near-natural forests.

occurrence of fruitbodies

The basidiocarps are produced from summer till autumn (June - October).

threats

In the European scale the fungus is endangered (?). Sites are mainly threatened by deforestation of old growth forest habitats in consequence of silvicultural intensification.

status of conservation

The species is red listed in Czech Republic, Finland, France, Norway, Poland, Slovakia, and Sweden. About 90 percent of current known sites are located in Sweden and Finland. That's why these countries have a particular responsibility for the maintenance of this species in Europe.

46. *Strobilomyces strobilaceus* (Scop.: Fr.) Berk.

geography

global distribution: Europe, Asia (Caucasus mountains, Kashmir, Russian Far East, Japan), Africa (Altas mountains), North and Central America (Canada, USA, Mexico, Cuba)

distribution in Europe: ## The species occurs from the lowlands to mountainous regions (in Armenia up to 1400 msm, also e.g. in Austria, Bulgaria, and Russia above 1200 msm).

areal diagnosis for Europe: ##

frequency

number of current known sites: more than 1000

centres of abundance: mainly France (?), Germany, partly Austria, Czech Republic, Denmark, Italy, Sweden (what else, Belgium?)

changes in frequency: From Armenia, Hungary, Latvia, Poland, and Slovenia a decrease is reported for the last 2 -3 decades, from The Netherlands for the last 5 decades. In Austria, France, Slovakia, and Spain no changes have been noticed. For Estonia there is no record after 1961. For Romania and UK even an increase of sites is reported for the last decades (due to an increase of field research?).

symbiont

The fungus lives in ectomycorrhizal symbiosis with deciduous and coniferous trees, in Western and Central Europe it prefers *Fagus sylvatica* (ssp. *moesiaca* in Montenegro, *Fagus sylvatica* also in Russia?), in more Southern regions there is outside the mountains a preference for *Quercus* spp. and *Pinus sylvestris*. The following further tree species are reported as symbionts *Betula pendula* (UK), *Carpinus betulus* (e.g. Hungary), *Fagus orientalis* ? (Armenia), *Quercus cerris* ? (Hungary), *gussonei* ? [Italy], *ilex* (Italy), *petraea*, *pubescens*, *robur* (e.g. Lithuania), *Tilia cordata*, and from the Pinaceae especially in mountainous regions *Abies alba*, *Picea abies*, and *Larix decidua* (Germany). The fungus is assigned as related to the *Clitocybe brumali*-*Phellodonetum nigri* (Czech Republic).

habitat

vegetation: The fungus is able to inhabit a wide range of forest types. It mainly occurs in deciduous forests, most often in beech forests, furthermore e.g. in oak and oak hornbeam forests. It is also reported for sclerophyllous oak forests (Italy), for several types of mixed forests (e.g. in Russia beech fir forests), and for coniferous forests, mainly mountainous spruce forests (e.g. Poland) but also lowland pine forests (e.g. in Germany and Poland moss and lichen rich). The species also find suitable conditions in plantations, especially in spruce plantations in Central Europe. Seldom it occurs synanthropic in hedges and in parks (Germany, Poland).

syntaxa of vegetation: *Fagion sylvaticae*, *Quercetum mixtum* (both Bulgaria), *Dentario enneaphylli*-*Fagetum* (Czech Republic), *Fagion sylvaticae*, *Galio odorati*-*Fagenion*, *Galio odorati*-*Fagetum*, *Hordelymo*-*Fagetum*, *Carici*-*Fagetum*, *Luzulo*-*Fagetum*, *Tilio*-*Acerion*, *Adoxo moschatellinae*-*Aceretum*, *Carpinion betuli*, *Galio sylvatici*-*Carpinetum*, *Stellario holostea*-*Carpinetum betuli*, *Genisto tinctoriae*-*Quercenion robori-petraeae*, *Genisto tinctoriae*-*Quercetum petraeae*, *Holco mollis*-*Quercetum*, *Vaccinio-Abietetum*, *Luzulo-Abietetum*, *Leucobryo*-*Pinetum* (all Germany), *Quercion pubescenti-petraeae*, *Quercio petraeae*-*Carpinetum*, *Quercetum petraeae-cerris*, *Melittio*-*Fagetum*, *Deschampsio flexuosae*-*Fagetum* (all Hungary), *Tilio-Quercetum* (Lithuania), *Festuco heterophyllae*-*Fagetum*, *Calamintho grandiflorae*-*Fagetum* (both Macedonia), *Fagetum moesiaca* *montanum* (Montenegro), *Fagetalia*, *Dicrano-Pinion*, *Vaccinio-Abietion*, *Vaccinio-Piceion* (all Poland), *Symphyto cordati*-*Fagetum*, *Carpino*-*Fagetum*, *Abieti*-*Fagetum* (all Romania), *Fago-Quercetum* (The Netherlands)

Natura 2000 habitats: ##

soil requirements: The euryoecious species inhabits a wide range of soils. Most often it was found on fresh to damp soils not too acid and too poor in nutrients (clayey brown soil is most typical, but also found on ranker, rendzina, regosol, podzol; geological underground diabases, gypsum (both Germany), limestone, granite (e.g. Bulgaria, Macedonia), sandstone, schist (Germany). In regions with drier climate it prefers comparatively wet soils (e.g. Slovenia, Spain), occasionally it was found on distinct dry and warm soils (e.g. Italy), seldom at oligotrophic sites (e.g. Germany), but never at eutrophic ones. The fungus mainly was found on a thin litter layer but tolerates also its absence or a thick one (Denmark, Spain).

indicator value

As a rather euryoecious fungus it doesn't possess a very good indicator value. It can be regarded as typical for mesophilous deciduous forests.

synanthropy

The species occurs in different kinds of wooded areas, mainly in forests but also in plantations and other anthropogenic habitats.

occurrence of fruitbodies

The basidiocarps are produced from early summer till autumn (June - November).

threats

In the European scale the species is not endangered (?). Sites are mainly threatened by silvicultural intensification (e.g. clear felling and fertilisation of coniferous forests).

status of conservation

The species is red listed in Armenia, Bulgaria, Estonia, France (?), Hungary, Latvia, Montenegro, Poland, Russia, The Netherlands, and Ukraine. The fungus is protected by law in Hungary, Poland, Serbia, Slovenia, and Ukraine.

47. Suillus flavidus (Fr.: Fr.) J.S. Presl

geography

global distribution: Europe, Asia (Western Siberia), North America (USA, regarded as conspecific with *Suillus umbonatus* Snell & Dick)

distribution in Europe: ## The species occurs from the lowlands to mountainous regions (e.g. in France and Slovenia above 1200 msm).

areal diagnosis for Europe: ##

frequency

number of current known sites: about 500 (?)

centres of abundance: Finland, France, Germany, **Sweden?**

changes in frequency:

For France, Germany, and The Netherlands a decrease is reported for at least the last 5 decades. In Estonia, Finland, Lithuania, Poland, Slovakia, and Spain no changes have been noticed. For UK even an increase of sites is reported (**due to an increase of field research?**).

symbiont

The fungus lives ectomycorrhizal and always in symbiosis with *Pinus*, mainly *P. sylvestris* in the low- and uplands and *P. mugo* s.l. in the mountains (ssp. *rotundata* and *uncinata*) and in Northern Europe (introduced to Iceland with *Pinus mugo*). From Sweden it is also recorded for the planted North American *Pinus contorta*, **from Denmark even for *Picea abies* (?)**. Mostly the fungus forms fruitbodies among *Sphagnum* spp.

habitat

vegetation: The fungus mainly inhabits peat bogs, transitional mires and boggy to swampy pine forests (e.g. with *Erica tetralix* [Poland]), occasionally in wet to moist pine forests without distinct peat layer (e.g. in dune areas [Germany]), in Ukraine also in wet oak pine forests. In Germany and UK the species was also found in pine plantations, in Czech Republic even at fishpond margins under pine (**influenced by man ?**).

syntaxa of vegetation: Pinetum calluneto-vaccinietosum (Czech Republic), Oxycocco-Sphagneteta, Scheuchzerio-Caricetea nigrae, Dicrano-Pinion, Pyrolo-Pinetum, Vaccinio uliginosi-Pinetum rotundatae, Ledo-Pinetum sylvestris, Vaccinio uliginosi-Betuletum pubescentis, Betuletum carpaticae (all Germany), Vaccinio uliginosi-Pinetum sylvestris (Germany, Poland, Romania), Eriophoro vaginati-Pinetum sylvestris (Romania)

Natura 2000 habitats: ##

soil requirements: It is a distinct hygrophilic species, often found on strong acid to nearly neutral oligotrophic to mesotrophic peat (histosols), sometimes also on wet to moist nutrient-poor acid podzols, from Romania also reported for acid brown soils and for Iceland from andosol (geological underground granite and volcanic rocks [Romania]).

indicator value

The species is typical for natural and near-natural wet wooded habitats (bogs, mires, swampy and boggy forests).

synanthropy

The species is to be regarded as anthropophobic. Only exceptionally it was found in biotopes moderately influenced by man.

occurrence of fruitbodies

The basidiocarps are produced from summer to autumn (July - October), in Spain still in November.

threats

In the European scale the fungus is not endangered (?). In the past the number of sites were decreased mainly by large-scale draining of bogs and mires.

status of conservation

The species is red listed in Austria, Czech Republic, Denmark, France, Germany, Poland, Slovakia, and The Netherlands. The fungus is protected by law in Czech Republic, Slovakia, and Slovenia.

48. Suillus sibiricus Sing.

remark: In Europe only the subspecies helveticus Sing. occurs, which is limited to the European continent.

geography

global distribution: Europe, Asia (Siberia)

distribution in Europe: ## The species only occurs in higher mountains (subalpine zone above 1200 msm).

areal diagnosis for Europe: ##

frequency

number of current known sites: about 60

centres of abundance: Switzerland

changes in frequency: In France and Macedonia no changes have been noticed.

symbiont

The species forms ectomycorrhiza with *Pinus cembra* in the Alps and the Tatra mountains (in France also other *Pinus* species?, why “mainly P. cembra”?), and with *Pinus peuce* in the mountains of the Balkan peninsula.

habitat

vegetation: The fungus mainly occurs in subalpine stands of *Pinus cembra*, either in forests and scrubs (dwarf pine zone), or in extensively used pastures with scattered trees. In Poland it grows among *Vaccinium myrtillus*. Twice the species was found synanthropic, in Lithuania at *Pinus cembra* and in Czech Republic in a park at *Pinus peuce*.

syntaxa of vegetation: *Pinion peucis* (Bulgaria), *Rhododendro-Vaccinion*, *Juniperion nanae*, *Rhododendro hirsuti-Pinion mugo* (all France), *Digitali viridiflorae-Pinetum peuces* (Macedonia), *Pinetum mugo carpaticum* (Poland)

Natura 2000 habitats: Alpine *Larix decidua* – *Pinus cembra* forests (code 9420, France, Germany, Italy, Poland, Switzerland)

soil requirements: The species mainly inhabits acid soils, but occasionally also neutral and basic ones (Bulgaria, France, and Switzerland). Reported soil types are brown soil (Bulgaria), podzol (Macedonia), and ranker (e.g. Poland), geological undergrounds are granite (e.g. Macedonia, Slovakia), marble and shist (both Bulgaria). The nitrogen content has to be low or moderate (in Macedonia also high?), the grain size ranges from sand to clay, and the litter layer from thin to thick.

indicator value

The species is characteristic for subalpine sites with *Pinus cembra* or *Pinus peuce*.

synanthropy

The fungus is mainly restricted to natural (forests) and near-natural habitats (extensively used wooded pastures), seldom it was found in anthropogenic habitats.

occurrence of fruitbodies

The basidiocarps are produced from summer to autumn (July - October).

threats

In the European scale the species is critically endangered (?). Sites are mainly threatened by logging of subalpine forests (e.g. to construct facilities for winter sport).

status of conservation

The species is red listed in Austria, Bulgaria, Czech Republic, France, Germany, Macedonia, Poland, Slovakia, and Switzerland. The fungus is protected by law in Slovakia. About 70 percent of current known sites are located in Switzerland. That's why this country has a particular responsibility for the maintenance of this species in Europe.

49. *Torrendia pulchella* Bres.

geography

global distribution: Europe, Africa (Atlas Mountains)

distribution in Europe: ## The species mainly occurs in the lowlands, seldom above 1200 msm (Spain).

areal diagnosis for Europe: ##

frequency

number of current known sites: about 100

centre of abundance: Spain.

changes in frequency:

For Spain an increase of sites is reported for the last 3 decades (due to an increase of field research?). In France no changes have been noticed.

symbiont

It is an ectomycorrhizal fungus living in symbiosis with the following trees and shrubs *Pinus pinaster*, *pinia*, *Quercus ilex*, *pyrenaica* ?, *robur*?, *rotundifolia*?, *suber* and *Cistus* spp., possibly also with *Castanea sativa* ? (Spain).

habitat

vegetation: The species only occurs in Mediterranean and Sub-Mediterranean forests and scrublands. It was found in deciduous and sclerophyllous oak woods, in pine forests, coastal wooded dunes with pines, in macchias and in garigues with *Cistus*.

Natura 2000 habitats: Wooded dunes of the atlantic, continental and boreal region (code 2180, France), Wooded dunes with *Pinus pinia* and/or *Pinus pinaster* (code 2270, Portugal), Galicio-Portuguese oak woods with *Quercus robur* and *Quercus pyrenaica* (code 9230, Spain), *Castanea sativa* woods (code 9260, Spain), *Quercus suber* forest (code 9330, France, Spain), *Quercus ilex* and *Quercus rotundifolia* forests (code 9340, Spain), Mediterranean pine forests with endemic mesogean *Pinus* (code 9540, Spain)

soil requirements: The inhabited soils are sandy, acid to more or less neutral, and often distinct dry (podzols and regosols, from Spain wet soils are reported ?). The nitrogen content is low to moderate, a litter layer is absent or poorly developed.

indicator value

It is a characteristic fungus of Mediterranean wooded biotopes on sandy soils.

synanthropy

The fungus occurs in natural and semi-natural habitats and avoids those strongly influenced by man.

occurrence of fruitbodies

The basidiocarps occur in spring (March - June) and in autumn (October - November).

threats

In the European scale the species is endangered (?). Sites are threatened e.g. by deforestation, overgrazing and fires.

status of conservation

The species is red listed in France, Italy, and Spain. About 90 percent of current known sites are located in Spain. That's why this country has a particular responsibility for the maintenance of this species in Europe.

50. *Tricholoma colossus* (Fr.) Quéf.

geography

global distribution: Europe, North America (USA)

distribution in Europe: ## The fungus mainly occurs in the lowlands, occasionally in mountainous regions (above 1200 m in Austria, Bulgaria).

areal diagnosis for Europe: ##

frequency

number of current known sites: about 220

centres of abundance: Spain, France, Sweden, Norway

changes in frequency:

For France, Germany, Sweden, and The Netherlands a decrease is reported for the last 100 years, for Lithuania for the last 5 decades, for Portugal a strong decrease for the last 10 years (?).

For Austria there is no record after 1982, for Estonia after 1959, and for The Netherlands after 1928. In Spain no changes have been noticed. For UK even an increase of sites is reported (due to an increase of field research?, not supported by the numbers of the Bern Convention document).

symbiont

The species lives ectomycorrhizal and nearly always in symbiosis with *Pinus*, in temperate and boreal regions mainly with *P. sylvestris*, in more Southern or continental regions also with *Pinus laricio* and *salzmannii* (both France), *nigra* (e.g. Bulgaria, Croatia), *pallasiana* (Ukraine), and *pinaster* (e.g. Italy, Portugal). In France the fungus was found in mycorrhiza with *Cedrus*, in Poland even without conifers under *Carpinus* and *Quercus* (?). There is a debatable record for *Picea abies* from Estonia.

habitat

vegetation: It is a characteristic fungus of nutrient-poor moss and lichen rich pine forests up to the taiga zone. It also occurs in mixed forests (e.g. chestnut pine in Italy), sometimes in heaths (e.g. Finland), coastal sand dunes with pine (Portugal) and in Mediterranean *Erica* scrubs with pine (France). Occasionally it colonises pine plantations (e.g. Denmark, in Germany also such of *Pinus nigra*). From Poland a finding in an oak hornbeam forest is reported (without pine?). Rarely the fungus was found distinct synanthropical in arboreta and parks (Ukraine).

syntaxa of vegetation: *Pinetalia sylvestris* (France), *Dicrano-Pinetum* (= *Cladonio-Pinetum*, = *Leucobryo-Pinetum*, Germany, Lithuania), *Tuberario lignosae-Callunetum* (Italy), *Vaccinio myrtilli-Pinetum*, *Querco-Carpinetum lathyretosum verni* with *Pinus* ? (= *Stellario holostaeae-Carpinetum*, both Poland)

Natura 2000 habitats: Wooded dunes with *Pinus pinea* and/or *Pinus pinaster* (code 2270, Portugal), Western taiga (code 9010, Estonia, Finland, Latvia, Lithuania, Sweden), Coniferous forests on, or connected to, glaciofluvial eskers (code 9060, Finland, Latvia, Lithuania, Slovenia, Sweden), Subalpine and montane *Pinus uncinata* forests (code 9430, Switzerland), Sub-Mediterranean pine forests with endemic black *Pinus* (code 9530, France?, *Pinus nigra* not native in France!), Mediterranean pine forests with endemic mesogean *Pinus* (code 9540, France, Italy), Caledonian forest (code 91CO, UK)

soil requirements: The species often colonises distinct dry, acid and oligotrophic soils (especially podzols and regosols, seldom brown soils [e.g. Bulgaria, Poland]), rarely it inhabits also damp sites (geological underground e.g. granite, phyllite [Germany], sandstone [e.g. Italy]). In Austria, Bulgaria, and Estonia the fungus also was found on calcareous soil above limestone. The soils are mainly sandy, seldom silty or clayey (e.g. Bulgaria), the litter layer is absent or thin.

indicator value

The species is characteristic for natural and near-natural oligotrophic pine forests.

synanthropy

The species tolerates a moderate anthropogenic influence in terms of planting

occurrence of fruitbodies

The basidiocarps are produced from summer to autumn (July - November).

threats

In the European scale the fungus is critically endangered (?). Sites are mainly threatened by eutrophication and silvicultural intensification.

status of conservation

The species is red listed in Bulgaria, Czech Republic, Denmark, Estonia, Finland, France, Germany, Poland, Latvia, Lithuania, Spain, Sweden, Switzerland, The Netherlands, and UK (in Russia only regional red listed). The fungus is protected by law in Lithuania.

51. *Tulostoma niveum* Kers.

geography

global distribution: not known outside Europe

distribution in Europe: ## The species exclusively occurs in the lowlands.

areal diagnosis for Europe: ##

frequency

number of current known sites: 9 ? (in the overview received from A. Dahlberg 25 current sites are mentioned for Sweden)

centres of abundance: Sweden and UK

changes in frequency:

For Sweden a decrease is reported for the last 100 years. For UK even an increase of sites is reported (due to an increase of field research?, but this is in contradiction to the numbers of the list for Bern Convention).

substratum

The species lives saprobic in dense moss tussocks on calcareous rocks and boulders. It is to be regarded as bryophilous and humicolous.

habitat

vegetation: The extrem stenoeccious fungus occurs in different open mossy biotopes above calcareous substrates. Mainly it was found at rocky sites with dominating mosses, occasionally in xerophytic grasslands and heaths.

Natura 2000 habitats: Alpine and boreal heaths (code 4060, UK), Rupicolous calcareous or basiphilic grasslands of the *Alyso-Sedion albi* (code 6110, Sweden), Fennoscandian lowland species-rich dry to mesic grasslands (code 6270, Finland), Nordic alvar and precambrian calcareous flatrocks (code 6280, Sweden), Calcareous and calcshist screes of montane to alpine levels (code 8120, UK), Calcareous

rocky slopes with chasmophytic vegetation (code 8210, Finland), Limestone pavements (code 8240, Sweden)

soil requirements: At the sites distinct soils are not present. The fungus colonises humus at the basis of moss tussocks above calcareous substrates (e.g. limestone, calcshist).

indicator value

The species is a very good indicator for mossy microhabitats on basic rocks.

synanthropy

The fungus only occurs in natural and near-natural open biotopes.

occurrence of fruitbodies

The basidiocarps are produced in spring (April – May) and in the summer autumn period (August - November). Because of their comparatively high persistence they can be found all over the year.

threats

In the European scale the fungus is critically endangered (?). It is mainly threatened by eutrophication of sites which promotes seed plants and suppresses mosses, trampling by man is a negative side effect.

status of conservation

The species is red listed in Finland, Sweden, and UK. **Eight from nine current known sites (?)** are located in Sweden and UK. That's why these countries have a particular responsibility for the maintenance of this species in Europe.