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Introducing Discomycetes.org: An online platform dedicated to apothecial fungi

Lestari AS[1,2,3,4], Ekanayaka AH[2,5], and Chethana KWT[1,2]

[1] *School of Science, Mae Fah Luang University, Chiang Rai 57100, Thailand*
[2] *Center of Excellence in Fungal Research, Mae Fah Luang University, Chiang Rai 57100, Thailand*
[3] *Mushroom Research Foundation, 128 M.3 Ban Pa Deng T.Pa Pae, A.Mae Taeng, Chiang Mai 50150, Thailand*
[4] *Research Organization for Life Sciences, National Research and Innovation Agency (BRIN), Cibinong 16911, Indonesia*
[5] Faculty of Applied Sciences, University of Sri Jayewardenepura, Srilanka

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Abstract

There is an increase in the number of discomycetes and fungal taxonomic and phylogenetic investigations being conducted around the world. Previous research on discomycete fungi has been disjointedly documented. As a result, there is a need for an online platform to update the taxonomy and phylogeny of discomycetes. Discomycetes.org was created to provide a centralized location for updating the taxonomy, phylogeny, and ecological and economic significance of apothecial fungi.

Keywords – Ascomycota – Ascocarp – Database – Discomycetes taxa – Fungal webpage – Phylogeny – Species description – Taxonomy

Introduction

Discomycetes have undergone significant modifications in their classification and nomenclature in recent years, and this cosmopolitan class now encompasses 11 orders and 70 families, as documented by various studies (Ekanayaka et al. 2017, Ekanayaka et al. 2019a, Johnston et al. 2019, Wijayawardene et al. 2022). Traditionally, discomycetes have been defined based on their apothecial macromorphology, micromorphology, and chemical reactions (Pfister & Kimbrough 2001). However, the generic concept of some discomycetous taxa has been misleading due to the grouping of species based on similar morphologies in the past. The incorporation of molecular data into research has revealed unexpected results that mycologists never anticipated. For example, *Lichinodium*, which was originally placed in *Lichinomycetes* due to its lichenized form, was later transferred to *Leotiomycetes* based on morphology (particularly due to lack of haustoria) and multigene phylogeny (Prieto et al. 2019). Advances in DNA sequencing technologies and phylogenetic studies have shown that discomycetes are phylogenetically diverse (Spatafora et al. 2006, Wang et al. 2006, Quandt & Haelewaters 2021), with some families being paraphyletic (Peterson & Pfister 2010) or polyphyletic (Johnston et al. 2019). Currently, discomycetes are accommodated in two subphyla: *Taphrinomycotina* (*Neolectomycetes*) and *Pezizomycotina* (*Arthoniomycetes, Coniocybomycetes, Dothideomycetes*, *Eurotiomycetes, Geoglossomycetes, Lecanoromycetes, Leotiomycetes, Lichinomycetes, Orbiliomycetes, Pezizomycetes*) (Landvik et al.1993, Ekanayaka et al. 2017).

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Corresponding Author: K. W. Thilini Chethana – e-mail – kandawatte.thi@mfu.ac.th

Discomycetes species are morphologically and ecologically diverse, occupying various roles as saprobes, mutualists, parasites and pathogens. They can be found on plants, dead lignocellulosic substrates, dung, and soil in both terrestrial and aquatic settings (Beaton & Weste 1976, Abdullah & Webster 1981, Van Vooren & Moreau 2009, Elad et al. 2016, Lücking et al. 2016, Lestari et al. 2023). Certain discomycete species, such as *Botrytis cinerea,* have garnered attention in research due to their severe pathogenic status on various agricultural plants (Dean et al. 2012). Others are known for their capability to synthesize secondary metabolites which have antibiotic capabilities (Quack et al. 1980), for culinary delicacies (Hall et al. 1998, Tietel & Masaphy 2018) and nematode predators (Pfister 1994). Additionally, endophytes include *Phialocephala* species (Tanney et al. 2016), coprophiles like *Ascobolus* species (De Sloover 2002), and pyrophiles (Dzhagan et al. 2020).

History of Discomycetes

The history of discomycetes can be traced back to Pliny in 23-79 AD, who discovered a mushroom without a root or stalk and named it 'Pezica'. Dillenius (1719) described *Peziza* as cup-shaped fungi or discomycetes (Kimbrough 1970). Fries established the Friesian classification of discomycetes based on apothecial macro characters, which remained in use for 60 years (Fries 1821). De Notaris (1864) provided detailed observations on discomycetes, focusing on characters such as asci, paraphyses, ascospore color, and excipulum cells. Nylander (1869) was the first to employ the iodine reaction for the classification of discomycetes. Boudier (1907) made significant contributions to discomycete classification, including the distinction between inoperculate and operculate discomycetes, the amyloid test, and oil drops in ascospores. Saccardo (1889) published his volume of Sylloge Fungorum, abandoning the Friesian method in favour of his prior discomycete classification system, raising many subgenera to the generic rank and describing over 200 genera with approximately 3,500 species. Nannfeldt (1932) critically re-evaluated several discomycete genera and proposed higher ascomycetes, namely *Plectoascales, Ascoloculares* and *Ascohymeniales*. Le Gal (1947) contributed to the understanding of ornaments and spore wall formations in operculate discomycetes. Dennis (1968) published "British Ascomycetes," a widely accepted work that included five orders of discomycetes: *Helotiales*, *Lecanorales*, *Pezizales*, *Phacidiales*, and *Ostropales*. Kimbrough (1970) further divided inoperculate divisions into *Helotiales*, *Ostropales*, and *Phacidiales*.

In the 19th century, advances in molecular studies with the DNA barcoding approach revolutionized studies on taxonomy and phylogeny of discomycetes. Landvik & Erikson (1994) documented the parsimonious tree of discomycetes, which was followed by Gargas & Taylor (1995), Landvik (1996) and O'Donnell (1997). This research revealed a paraphyletic assemblage for apothecial specimens, with *Helotiales* and *Pezizales* classified into distinct clades. Phylogenetic studies focused on discomycetes and pyrenomycetes were conducted by Lutzoni et al. (2004), James et al. (2006), Spatafora et al. (2006), Wang et al. (2006a, b) and Schoch (2009a, b). Jaklitsch et al. (2016) incorporated discomycetes taxa in their *Ascomycota* classification. Following that, Ekanayaka et al. (2018) summarized all classes comprising apothecial bearing species. Furthermore, subsequent studies have introduced and revised discomycetous taxa based on multi-gene phylogeny and morphology (Ekanayaka et al. 2019a, Johnson et al. 2019, Pfister & Healy 2021, Quandt & Haelewaters 2021). These advancements have led to the current classification of *Ascomycota* (Wijayawardene et al. 2022).

Discomycetes in the Classification of *Ascomycota*

Discomycetes in *Arthoniomycetes*

Discomycetes characterized by mostly lichenized, minute, dark-colored (with red pigments in some species), discoid to hysteriform apothecia are classified into *Arthoniomycetes* (Grube 2001, Kirk et al. 2008, Ertz et al. 2015, Lee & Hur 2016). Discomycete members of *Arthoniomycetes* are predominantly crustose lichens, as opposed to discomycetous *Lecanoromycetes*, which grow on crustose, foliose, and fruticose-thalli structures (Schoch & Grube 2015). Micromorphology of the

apothecia in *Arthoniomycetes* revealed a hymenial layer bordered on the outside by poorly defined excipulum cells (Ertz et al. 2009). The hymenium consists of gelatinous substances that are interspersed with paraphysoid and fissitunicate asci, bearing septate and ornamented ascospores (Schultz et al. 2001, Kirk et al. 2008). Discomycetous *Arthoniomycetes* have pycnidial or hyphomyceteous asexual morphs (Frisch et al. 2015, Vobis et al. 1992). Arthoniomycetous discomycetes are classified in a single order, *Arthoniales,* with the majority acting as mutualists and others as saprobes (Gargas et al. 1995, Ekanayaka et al. 2017).

Discomycetes in *Coniocybomycetes*

Discomycetes in *Coniocybomycetes* are characterized by mazaediate-form apothecia that are small, dark, and stalked (Prieto et al. 2013). The hymenial layer in apothecia is bordered by less to well-defined excipulum cells (Prieto et al. 2013). Asci in the hymenium are prototunicate and cylindrical, with smooth to ornamented ascospores (Prieto et al. 2013). Coniocybomycetous discomycetes belong to a single order (*Coniocybales*), a single family (*Coniocybaceae*), accommodating two genera (*Chaenotheca* and *Sclerophora*), with the most species acting as mutualists (mycobionts) in lichens (Lücking et al. 2016, Wijayawardene et al. 2022). Discomycetes in this class have pycnidial or hyphomyceteous asexual morphs (Tibell 1993, Prieto et al. 2013).

Discomycetes in *Dothideomycetes*

Discomycetes in *Dothideomycetes* are categorized by medium to minute, dark-colored apothecia that are discoid, cupulate to hysteriform (Greif et al. 2007, Hongsanan et al. 2020). The hymenium is bordered by well-developed excipulum cells that are largely pigmented pseudoparenchyma cells of *textura subangularis, angularis* to *globulosa* (Greif et al. 2007, Boehm et al. 2009). Unitunicate to bitunicate asci in the hymenial layer are interspersed with pseudoparaphyses to paraphyses with swollen apices (Kutorga & Hawksworth 1997, Greif et al. 2007, Thambugala et al. 2016). Discomycetous *Dothideomycetes* have hyaline to pigmented, septate-ascospores (Greif et al. 2007, Thambugala et al. 2016). Discomycetes in *Dothideomycetes* are found in *Catinellales, Eremithallales, Hysteriales, Mytilinidiales, Patellariales* and *Pleosporales* (Ekanayaka et al. 2017), with most species serve as mutualists (Lücking et al. 2008), saprobes (Yacharoen et al. 2015) and biotrophic pathogens (Inácio & Canon 2008, Lestari et al. 2023). Dothideomycetous discomycetes are typically found on lignocellulose substrates in terrestrial or occasionally marine habitats (Boehm et al. 2009, Jones et al. 2015). The asexual morphs in this class are often coelomycetous or sometimes hyphomyceteous (Boehm et al. 2009, Yacharoen et al. 2015).

Discomycetes in *Eurotiomycetes*

In *Eurotiomycetes*, discomycetes are characterized by minute, dark-colored, sessile or stalked apothecioid sexual morph or mazaedial ascomata (Alexopoulous et al. 1996, Döbbeler & Feuerer 2004, Jaklitsch et al. 2016, Olariaga et al. 2019, Prieto et al. 2021). The hymenial layer comprises cylindrical asci, that contain pigmented ascospores (Wedin & Tibell 1997). Discomycetes are divided into two orders and two families in *Eurotiomycetes* (Ekanayaka et al. 2017, Réblová et al. 2017), with the majority being saprobes on lignocellulose substrates (Vinuesa et al. 2001) and biotrophic pathogens (Döbbeler & Feuerer 2004). Discomycetes in *Eurotiomycetes* are mostly found as hyphomyceteous asexual morphs (Geiser et al. 2006).

Discomycetes in *Geoglossomycetes*

All *Geoglossomycetes* members are discomycetes with dark to brightly colored, stalked apothecia that range from medium to large (Hustad et al. 2013). The apothecial cross section shows pigmented, filiform ascospores in cylindrical clavate asci (Schoch et al. 2009b). *Geoglossomycetes* accommodates a single order, *Geoglossales,* a single family *Geoglossaceae* and seven genera (Schoch et al. 2009b, Hustad et al. 2013, Wijayawardene et al. 2022). Most *Geoglossomycetes* are saprobes in the soil, while some are root endophytes (Hustad et al. 2013, Wang et al. 2011). Unlike

other discomycetes in other classes, asexual morphs for *Geoglossomycetes* are not recorded (Wang et al. 2006).

Discomycetes in *Lecanoromycetes*

Discomycetes in *Lecanoromycetes* are characterized by medium to small, lichenized or non-lichenized apothecia (Miadlikowska et al. 2006, Schoch et al. 2009a). Lichenized apothecia with bright to dull colors can be found in crustose, foliose, and fruticose thalli structures (Honegger 1978, Ekanayaka et al. 2019b). The hymenial layer in apothecia is made up of branched paraphyses and inoperculate asci that bear hyaline, aseptate to septate ascospores (Magain & Sérusiaux 2012, Lumbsch et al. 1995). *Lecanoromycetes* is the most speciose class of discomycetes among the Ascomycota classes, containing 16 orders (Kirk et al. 2008, Ekanayaka et al. 2017). Discomyceteous *Lecanoromycetes* are found mostly as mutualists on lignocellulose substrates (Brodo et al. 2001, Wedin et al. 2004), some as parasites on other lichens (Lawrey & Diederich 2003) as saprobes (Sherwood-Pike 1987). In *Lecanoromycetes*, the asexual morphs are pycnidial or hyphomycetous (Ertz et al. 2012, Miadlikowska et al. 2014).

Discomycetes in *Leotiomycetes*

Leotiomycetes is the second-largest class encompassing approximately 80,000 discomycetous species after *Lecanoromycetes* (Ekanayaka et al. 2017, Johnston et al. 2019). *Leotiomycetes* are characterized by medium to minute, bright to dull colored, stipitate or sessile, immersed apothecia that are typically disc-, saucer-, or honeycomb-shaped (Wang et al. 2006, Johnston et al. 2019). This class of apothecia has a hymenial layer with mostly inoperculate asci carrying hyaline to brown and ovoid, ellipsoid, fusoid to filiform ascospores (Karakehian et al. 2019, Quijada et al. 2022).

Leotiomycetes is the most perplexing class, with controversial taxa placements (Berbee et al. 2001, Quandt & Haelewaters 2021). The majority of *Leotiomycete*s are saprobes (Hansen 2006, Laessoe & Hansen 2007), others are phytopathogens (Peterson et al. 2010), and some are mutualists as endophytes, ectomycorrhizal fungi and lichens (Chang et al. 2016, Tanney et al. 2016, Prieto et al. 2019). Currently, *Leotiomycetes* accommodates more than ten classes of discomycetous species (Quandt & Haelewaters 2021, Wijayawardene et al. 2022). The asexual morphs of this class are mostly hyphomycetous (Ingold 1979), pycnidial (Crous et al. 2014) and coelomycetous (Lantz et al. 2011).

Discomycetes in *Lichinomycetes*

Discomycetes in *Lichinomycetes* are characterized by lichenized, small and immersed apothecia (Schultz et al. 2007, Ortiz-Alvarez et al. 2015). The apothecia consist of protunicate asci, enveloped by a gelatinized layer (Schultz & van den Boom 2007). Kirk et al. (2008) describe ascospores enclosed in asci as hyaline and aseptate. Discomycetes in *Lichinomycetes* are found in a single order (*Lichinales*), accommodating a single family (*Gloeoheppiaceae*) and three genera (*Gloeoheppia, Gudelia,* and *Pseudopeltula*) (Ekanayaka et al. 2017, Wijayawardene et al. 2022). The asexual morphs of this class are mostly pycnidial (Schultz et al. 2001).

Discomycetes in *Neolectomycetes*

The only class accommodating discomycetes in the subphylum *Taphrinomycotina* is *Neolectomycetes*, with *Neolectales* as the only order (Landvik et al. 1993, Eriksson & Winka 1997). Members of *Neolectales* have club-like apothecia, similar to *Microglossum* (*Leotiales, Leotiomycetes*). They differ, however, in that they have a truncated ascus and lack paraphyses and croziers (Landvik et al. 2003, Ekanayaka et al. 2019b). All members of *Neolectomycetes* are discomycetes having diverse ecological roles, mostly saprobes with a few parasitic biotrophs (Redhead 1979, Landvik et al. 2003). The asexual morphs of this class produce conidia to a yeast form (Redhead 1977).

Discomycetes in *Orbiliomycetes*

Orbiliomycetes was previously enlisted as a family, *Orbiliaceae*, in *Helotiales* (Nannfeldt 1932, Kimbrough 1970). *Orbiliales* is the only order in this class (Eriksson et al. 2003). *Orbiliomycete* apothecia are disc-shaped, medium to small, stipitate to sessile, translucent, and brightly or dull colored (Baral 1994, Baral et al. 2021). The apothecia comprised a waxy to gelatinous matrix, inoperculate asci with variously shaped ascospores, and bordered by *textura globulosa* cells (Baral et al. 2021). Discomycetous *Orbiliomycetes* play diverse ecological roles, mostly as saprobes, parasites and mutualists (Baral et al. 2020). Pfister (2015) discovered orbiliomyceteous specimens on dung, soil and plant-associated materials. The asexual morph of this class is mostly hyphomycetous (Baral et al. 2017).

Discomycetes in *Pezizomycetes*

Pezizomycetes are discomycetes with medium to large apothecia, mostly operculate asci that discharge ascospores via rupturing or through lid-like ascal tip (Hansen & Pfister 2006). *Pezizomycete* apothecia are distinguished not only by their large sizes but also by their attractive colors, which include pink, orange, red, yellow, and white, with others being brown, grey and black (Denison 1963, Hansen & Pfister 2006). Apothecial shapes of *Pezizomycetes* varied from discoid, cupulate, and applanate to bizarre shapes, such as honeycomb-like to elfin-saddle-like (Clements & Shear 1954). The cross-section of the apothecium shows a hymenial layer with a well-developed ectal excipulum and a variety of asci and ascospores (Spooner 2001, 2002, Ekanayaka et al. 2018).

Most species in *Pezizomycetes* live above ground and have active ascospore dispersal mechanisms, whereas *Tuberales* species live beneath the soil and have diminished ascospore dispersal mechanisms (Hansen 2006, Læssøe & Hansen 2007). Discomycetes in *Pezizomycetes* are found in 18 families, including *Pezizales* genera *incertae sedis* (Wijayawardene et al. 2022), and play predominantly saprobic (Perry et al. 2007), others as pathogenic (Cha et al. 2009, Lestari et al. 2023) and mutualistic ecological roles (Wei et al. 2010). The asexual morphs of *Pezizomycetes* are mostly hyphomycetous (Hansen & Pfister 2006).

The significance of Discomycetes.org

Mycological research groups worldwide are conducting studies on discomycetes. For example, the Center of Excellence in Fungal Research, one such research group, contributed to the discomycete taxonomy with new geographical records, new taxa (species, genus, and family), re-descriptions and re-evaluation of certain taxonomic ranks, phylogenetic construction of new taxa and reconstruction of previously studied taxa based on molecular data (Ekanayaka et al. 2017, 2018, 2019a, b, Lestari et al. 2023). There is a trend to develop databases on various groups of fungi, e.g., Coelomycetes, Huanraluek et al. 2021; microfungi in the Greater Mekong Subregion, Chaiwan et al. 2021; Italian ascomycetes, Wijesinghe et al. 2021. Discomycete.org provides information on earlier but legitimate studies and regular updates on current studies on discomycetes worldwide. The purpose of this web-based platform is to compile all knowledge on discomycetes into a comprehensive, easily accessible system for mycologists worldwide. This website regularly updates the most recent taxonomic placements and descriptions of genera and species.

Significance of Discomycetes resource in the form of an online platform

In this internet era, young mycologists prefer to access mycological information online rather than in a book. However, online platforms highlighting discomycetes specimens are rarely available, especially those that provide complete morphological descriptions with photographs and up-to-date phylogenies. Due to the lack of online resources for discomycetes, information on the macro- and micromorphologies are difficult to access, particularly for taxa with old specimen records and descriptions. According to various multi-gene phylogenetic analyses, discomycetes, which were formerly placed in taxa based on the shape and morphology of sexual morph, are widespread in various classes of *Ascomycota* (Spatafora et al. 2006, Lumbsch & Huhndorf 2010, Pfister 2015,

Ekanayaka et al. 2018). Therefore, it is essential to construct a website and provide comprehensive information on taxonomy with phylogeny and their ecological roles.

Database construction

The online platform will include taxonomy and phylogeny and comprises taxa from Ekanayaka et al. (2018), followed by the most recent research on discomycetes (Ekanayaka et al. 2019a, 2019b, Tochihara & Hosoya 2022). Descriptions, illustrations and phylogenies of discomycetes taxa will be provided and updated regularly with their references. Each taxa entry on the website will be linked to Index Fungorum, Mycobank, Faces of Fungi (Jayasiri et al. 2015), Freshwaterfungi.org (Calabon et al. 2020), Fungal Genera (Monkai et al. 2019) and Outline of Fungi (Wijayawardene et al. 2022) websites.

This online platform encourages mycologists to share their knowledge, suggestions and contributions, especially on discomycetes research updates. The website (Discomycetes.org) is dedicated to providing comprehensive information, such as pathology issues, ecology and economic importance, and industrial significance.

Database interface and visualization

The online platform, https://www.discomycetes.org, compiles classification and taxonomic information on discomycetes and provides user-friendly access to the database (Fig 1–2). As illustrated in Fig. 5, a detailed description and picture of a particular discomycetes species will be provided. The website interface consists of ten headings, of which seven are described as follows:

1. **Home**: provides an overview of the discomycetes.org website, a reference when using the website and enables rapid access to the most recently submitted taxa entries (Fig. 1).
2. **Outline**: describes the current state of classification, taxonomy and phylogeny of discomycetes (Fig. 3).
3. **Archives**: provides a direct path to access specific taxa at the order level (Fig. 4).
4. **Curators**: provides list and contact information of discomycetes.org curators (Table 1).
5. **History**: offers a historical synopsis of the classification and taxonomy of discomycetes.
6. **References**: provides a list of publications referenced in the entries on discomycetes.org
7. **Notes:** contains up-to-date mycological news.
8. **Contac**t: provides contact details of the online platform, and the users can post suggestions and website-related questions.

Entries on discomycetes specimens uploaded to discomycetes.org were reviewed by the curators listed in Table 1, yet we are also open to suggestions from mycologists who will contribute further.

Table 1 List of curators of Discomycetes website

Position	Name	Affiliations	Correspondence
Head curator	Anusha H. Ekanayaka	Center of Excellence in Fungal Research, Mae Fah Luang University, Chiang Rai, Thailand	hasinie88@gmail.com
Managing curator	Anis S. Lestari	Center of Excellence in Fungal Research, Mae Fah Luang University, Chiang Rai, Thailand	anislestari1@gmail.com
Curators	Dhanushka Wanasinghe	Key Laboratory of Biodiversity and Biogeography, Kunming Institute of Botany Chinese Academy of Sciences Kunming, China	dnadeeshan@gmail.com

Table 1 Continued

Position	Name	Affiliations	Correspondence
	E. B. Gareth Jones	Department of Botany and Microbiology, King Saud University, Riyadh, Kingdom of Saudi Arabia.	torperadgj@gmail.com
	Kevin D. Hyde	Centre of Excellence in Fungal Research, Mae Fah Luang University	kdhyde3@gmail.com
	Robert Lucking	Botanischer Garten and Botanisches Museum, Berlin-Dahlem	r.luecking@bgbm.org
	K.W. Thilini Chethana	Centre of Excellence in Fungal Research, Mae Fah Luang University, Chiang Rai, Thailand	kandawatte.thi@lamduan.mfu
	Sajeewa Maharachchikumbura	University of Electronic Science and Technology, Sichuan, Chengdu, Chenghua, China	sajeewa83@yahoo.com
	Sinang Hongsanan	College of Life Science and Oceanography, Shenzhen University, Xili campus, Nanshan, Guangdong, China	sinang333@gmail.com
	Tian Qing	Centre of Excellence in Fungal Research, Mae Fah Luang University, Chiang Rai, Thailand	tianqing124@gmail.com
	Vincent P. Hustad	Department of Natural Sciences, Northwest Missouri State University, Maryville, Missouri, USA	vhustad@nwmissouri.edu
	Zeng Ming	Centre of Excellence in Fungal Research, Mae Fah Luang University, Chiang Rai, Thailand	z-ming@outlook.com

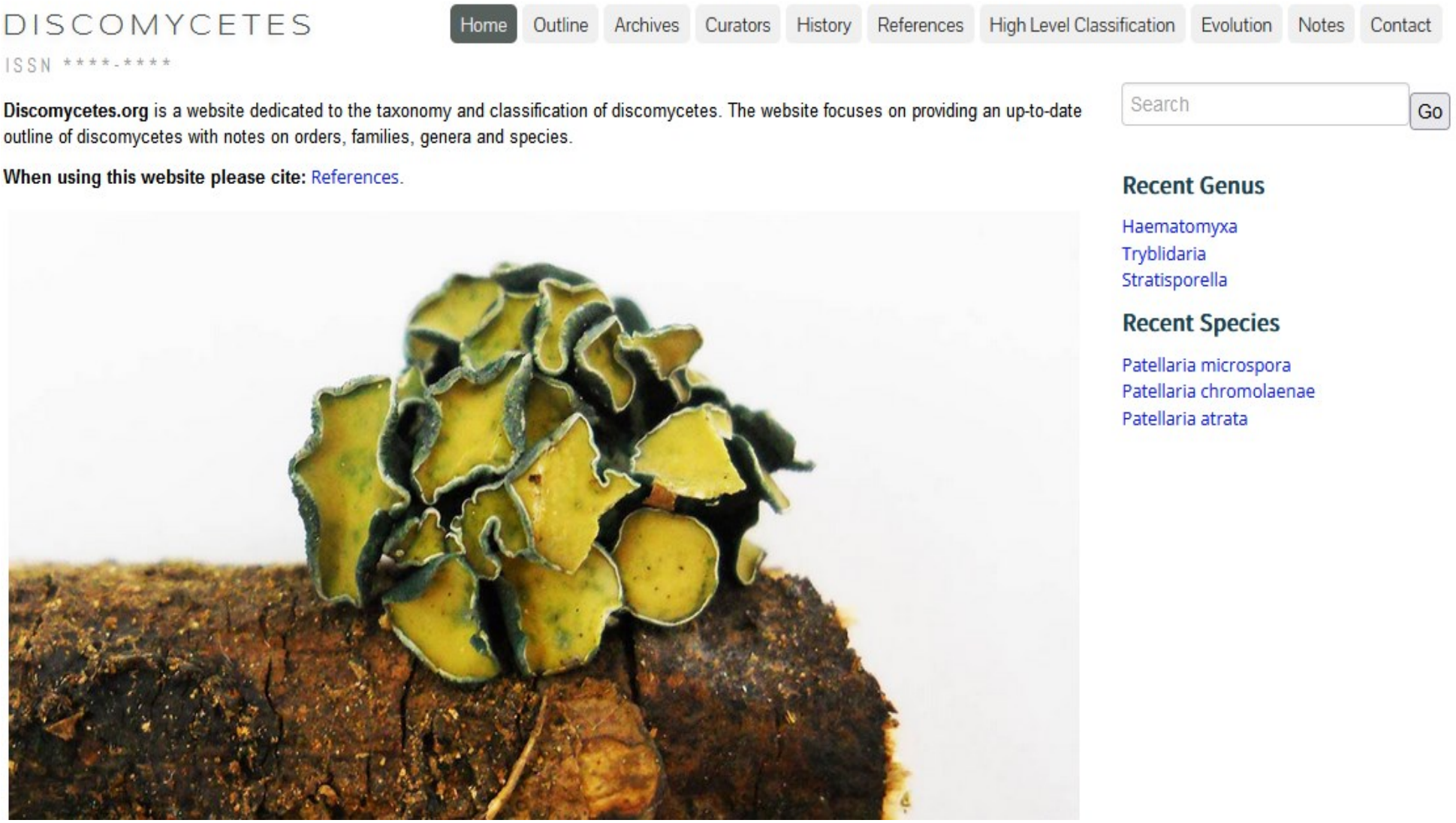


Fig. 1 – The homepage of Discomycetes.org

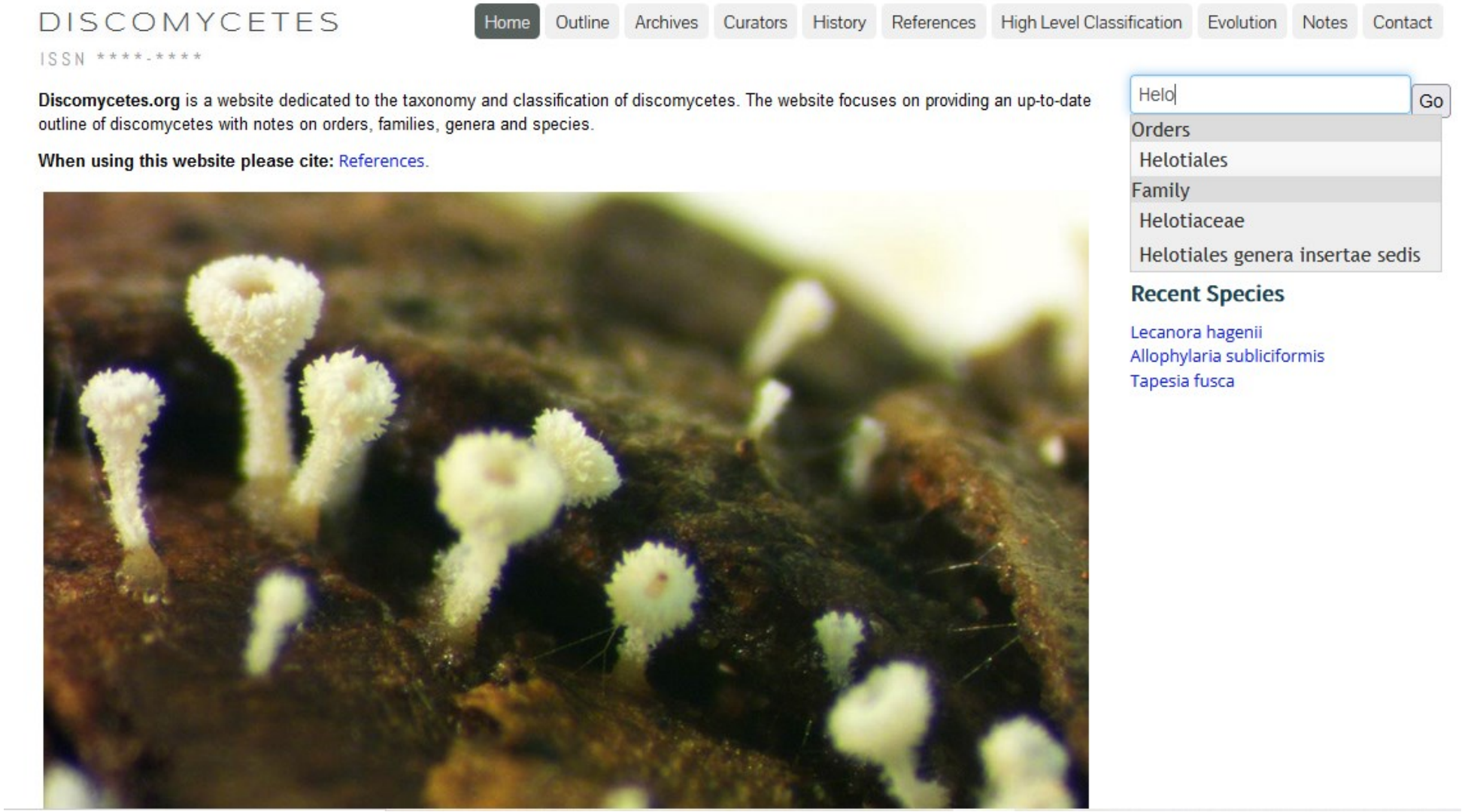


Fig. 2 – The search bar available for users to find specific discomycetes taxa

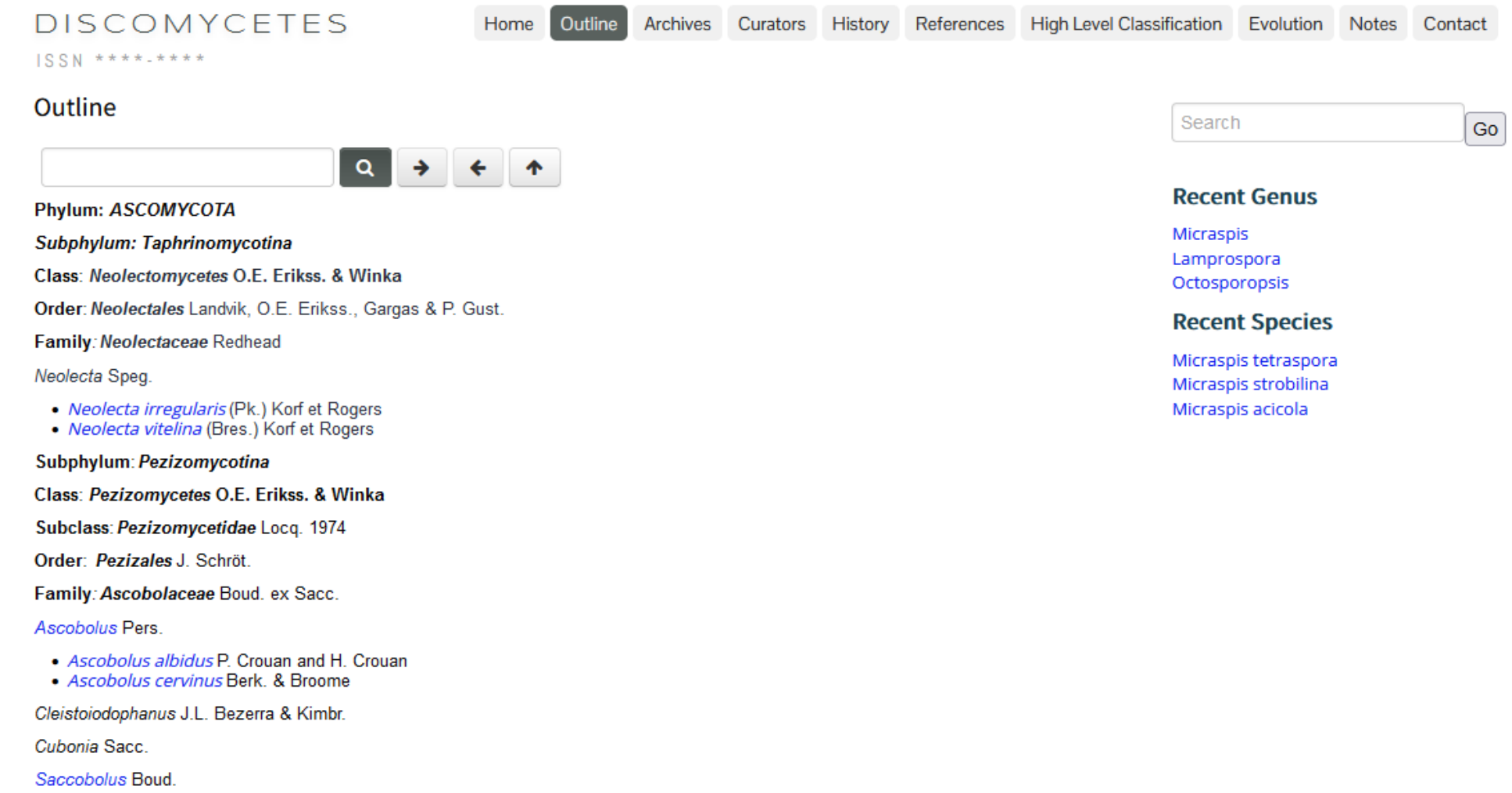


Fig. 3 – The snapshot of the outline page of the Discomycetes.org

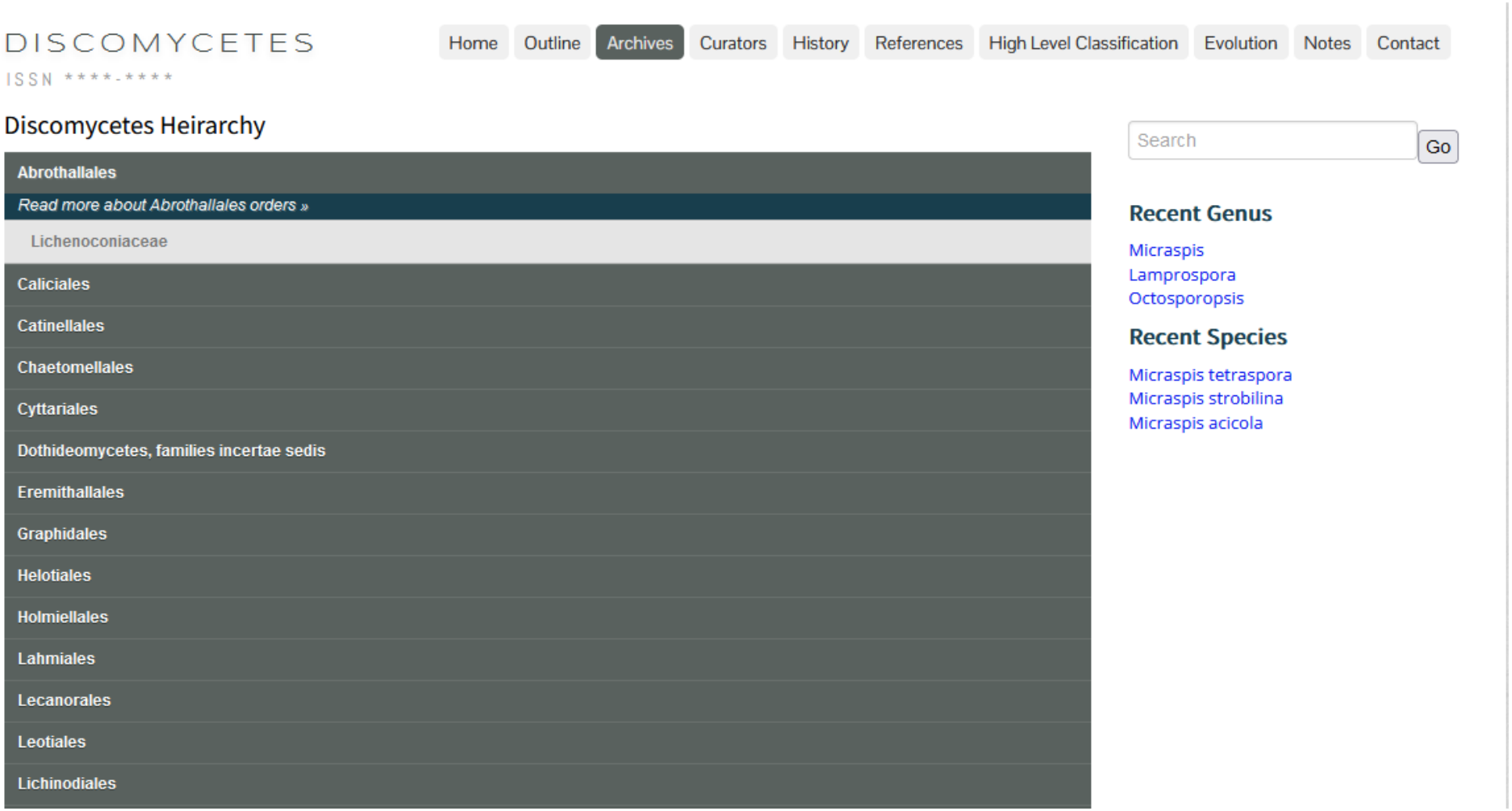


Fig. 4 – The snapshot of the archive page in Discomycetes.org

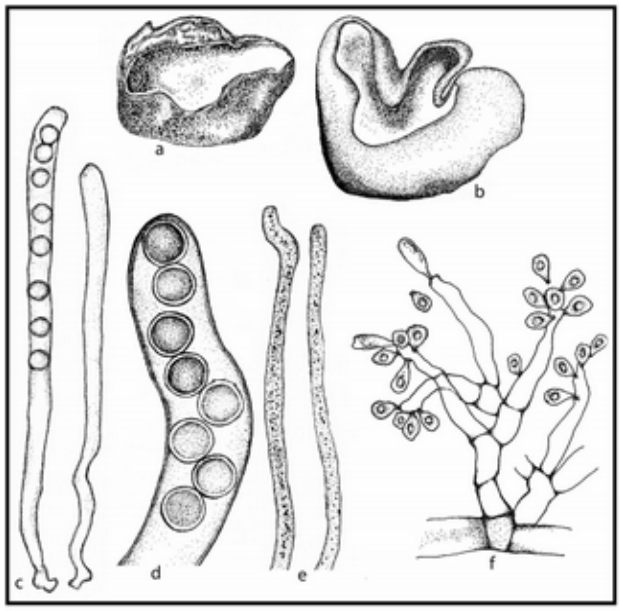
Pezizales » Caloscyphaceae » Caloscypha

Caloscypha fulgens

Caloscypha fulgens (Pers.) Boud., Bull. Soc. mycol. Fr. 1:103 (1885)
=*Geniculodendron pyriforme* G.A. Salt, Trans. Br. mycol. Soc. 63(2): 340 (1974)
Facesoffungi number: FoF 04203

Saprobic on soil or pathogenic on endosperm and embryo of Sitka spruce seed. **Sexual morph:** Apothecia up to 5 cm diam., gregarious, sessile to short stipitate, exterior surface dull yellow to yellowish-orange, with maturity become bluish-green to olive, especially near the margin. Receptacle cupulate, sometimes discoid at maturity. Margins lobed, concolorous to receptacle. Disc yelloworange to orange, glabrous. Paraphyses filiform, granulated. Asci 8-spored, operculate, inamyloid. Ascospores 5.5–7.5 µm, globose, smooth, hyaline. **Asexual morph:** Colonies on PDA coarse, white to pale brown. Aerial mycelium densely verrucose, white to pale brown. Submerged mycelium smooth, white, orange or brown. Conidiophores straight, erect, cylindrical, septate, highly branched, forming hyaline, dendroid structures, with a main axis, ultimate branches bearing conidiogenous cells. Conidiogenous cells polyblastic, borne singly, in pairs or verticillately and proliferating sympodially. Conidia form in successive apices of conidiogenous cells from sympodial succession, dry, acropetal, holoblastic, arising in clusters, aseptate, hyaline, pyriform, smooth-walled, guttulate, truncate at the attached end (Description modified from Salt 1974; Beug et al. 2014).

Notes: The sexual morph of *Caloscypha fulgens* is saprobic on soil and characterized by yellow apothecia which become bluish-green to olive at maturity, cylindrical operculate asci and globose hyaline ascospores (Beug et al. 2014). The asexual morph of *Caloscypha fulgens* is pathogenic on endosperm and embryo of Sitka spruce seed and characterized by its sympodially proliferating conidiogenous cells from which unicellular holoblastic conidia are formed (Salt 1974).



Morphology of *Caloscypha fulgens* a, b Habit of apothecia, c cylindrical asci, d ascal apex with globose ascospores, e filiform paraphyses, f conidiophore and conidia (Redrawn from Salt 1974; Jones 2017; Goodwin 2017; Stevens 2017)

Reference:

Ekanayaka AH, Hyde KD, Jones EBG, Zhao Q. 2018. Taxonomy and phylogeny of operculate discomycetes: Pezizomycetes. Fungal Diversity 90, 161–243

Recent Genus

Lecanora
Allophylaria
Tapesia

Recent Species

Lecanora hagenii
Allophylaria subliciformis
Tapesia fusca

Fig. 5 – A detailed description of *Caloscypha fulgens,* a species uploaded in Discomycetes.org

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