Lecture 7

Basidiomycota

The Agaricales

Examples of natural (evolutionary) groups
Three major ectomycorrhizal clades of Agaricales that correspond to genera traditionally recognized from their morphology

*Amanita*
- ca 800 known spp.
- white spore print
- at least a volva or an annulus present

*Cortinarius* & its secotioid *Thaxterogaster* form (previously classified in the Gasteromycetes)
- ca. 2000 known spp., mostly temperate
- usually brown gills and brown spore print
- remant of veil (cortine) visible at least in young fruiting bodies

*Inocybe*
- ca 200 known spp.
- cap usually dull brown, strongly umbonate
- usually brown gills and brown spore print
A. muscaria (fly agaric/hallucinogenic)
A. vaginata
A. virosa (death angel)
A. jacksonii (edible)

Amanita
Inocybe

www.biology.duke.edu/fungi/

plantbio.berkeley.edu/~bruns/nmh113/
**Secotiod forms in *Cortinarius***

- generally semi-hypogeous

- Derived multiple times from gilled forms

- previously recognized in a different genus (*Thaxterogaster*) in the Gasteromycetes; most abundant in the Southern Hemisphere
Marasmiaceae

Includes the gilled genera
- *Marasmius*
- *Lentinula* (shiitake - commercially grown)
- *Collybia* pro parte (*Gymnopus*, *Rhodocollybia*)
- etc.

Alos includes reduced forms, e.g.,
*Caripia*

*Gymnopus subnudus*

*Caripia montagnei*

*Marasmius rotula*
Growing Shiitake commercially

http://www.alcorn.edu/sfdc/Shiitake%20Mushrooms%20In%20Mississippi.htm

http://www.denison.edu/collaborations/ohmushroom/Shiitake.html

The Physalacriaceae

xeruloid clade (Physalacriaceae)

Includes the gilled genera
- *Xerula*
- *Armillaria*
- *Oudemansiella*
- *Cyptotrama*
- *Flammulina*
- *Strobilurus*

Reduced form:
- *Gloiocephala*
- *Physalacria*

**Common characters:**
All are primary colonizers of dead wood or leaves
Most (but not all) members have
- a hymeniform pileipellis
- secretory cystidia
- strobilurins (antibiotics)
- adaptation for colonization of subterranean material (e.g., mycelial cords, stipe deep in soil,...
Armillaria
The Mycenaceae

Generally small fungi; all taxa are saprophytes on litter and wood; many spp., especially in the tropics.

- the tropical, poroid, often pleurotoid genus *Favolaschia* is related to *Mycena* (gilled fungi), to which it shares many similar microscopic characters, e.g., white spore print, smooth spores etc.
- *Mycena* can be divided in many smaller genera based on spore amyloidy and microcharacters of the pileus.
Example of gill-pore transition
*Poromycena* sp. from Thailand
(mycenaceae clade)
Omphalotaceae

- on wood;
- bioluminescent;
- produce illudin (toxic)

*Lampteromyces japonicum*

*Omphalotus illudens*

(“Jack-o-lantern”)
The Lyophyllaceae

Common character:
- presence of siderophylous granules in the basidia

- *Termitomyces*:
termite-associated (tropical); edible

- *Asterophora*
mushroom parasite, often on *Russula*

- *Lyophyllum*
- *Calocybe*
- ...

*Termitomyces spp.*
(pics. D. Pegler)
Asterophora parasitica growing on a species of Russula

http://www.cegep-sept-iles.qc.ca/raymondboyer/champignons/Tricholomatacees_A-Cl.html

http://www.andoa.net/paginas/teoria/intro/detalles/aparasitica.html
Resupinatus clade: uncertain phylogenetic affinities

- morphologically very variable: includes pleurotoid and cyphelloid (cup-like) basidiocarps
- all primary decomposers on wood;
- gelatinous, at least in the pileus context.
The Pleurotaceae: nematophagous mushrooms

- ‘pleurotoid’ basidiocarp;
- white or pale spore print;
- smooth spores;
- some species are dimitic (presence of both generative and skeletal hyphae), at least when mature.

Two genera:
- **Pleurotus** (lacks metuloid cystidia)
  “oyster mushroom”, several spp. are commercially cultivated;
- **Hohenbeuhelia** (presence of metuloid cystidia)

Nematode-trapping via mycelial “hooks”, ........ or toxic droplets

Pics from G. Barron
The Agaricaceae

- brown spored, except *Lepiota* and *Leucoagaricus*
- ring (annulus) generally present
- all saprophytes
- often form fairy rings
- good at removing heavy metals (and radioactivity) from soil;

Gilled genera:
- *Agaricus*; includes the commercially cultivated “button mushroom”, or “champignon de Paris”.
- *Coprinus* sensu stricto, e.g., *Coprinus comatus* (the “inky cap”) and allies;
- *Leptotia*
- *Leucoagaricus*
- *Leucocoprinus*
- etc… (many genera)

Many puffballs, e.g., the *Lycoperdales* (“true puffballs”)
- *Lycoperdon, Calvatia*
Agaricus bisporus, the “button mushroom”, or “champignon de Paris”.

http://www.bluewillowpages.com/mushroomexpert/agaricus_bisporus.html

http://www.giornaledibrescia.it/iniziative/funghi/fungo04.htm
Longula texensis “Secotioid”:
A secotioid basidiocarp is confusingly intermediate between a typical gilled fungus and a Lycoperdon-like puffball
The Agaricaceae

Fungi associated with leaf cutter ants have been shown to be in this clade based on molecular data (fruiting bodies not found yet) - **G3 Attini fungi**

About 200 spp. of *Attini* ants cultivate fungi for food. (> 50 million years of farming fungi!)

The ants weed out invading fungi.

They also host bacteria in their body for secretion of an antifungal agent to kill unwanted molds.

Additional info @ http://anu.andong.ac.kr/~soongu/word/bioresources/ants/ant.htm
The Psathyrellaceae

= ‘The inky caps’, with the exception of the Shaggy Mane \textit{Coprinus comatus}

\textit{Coprinus} sensu modern authors is polyphyletic:

- The type species, \textit{Coprinus comatus}, is related to the Agaricaceae;
- Most \textit{Coprinus} species are now segregated into the genera \textit{Coprinopsis} and \textit{Coprinellus}, as already recognized by some authors in the early 20th Century.
- \textit{Coprinus cinereus} (now => \textit{Coprinopsis cinereus}) is a model organism in fungal genetics; it is one of the top listed basidiomycota for complete genome sequencing.

- black spore print;
- gills/cap generally deliquescent;
- often found on the ground but also saprophytes on wood;
- often grow gregarious;
- \textit{Psathyrella}
- \textit{Coprinopsis}
- \textit{Coprinellus}
Bird-nest fungi (ex-“Nidulariales”)
- traditionally in the Gasteromycetes with enigmatic evolutionary relationships to other fungi; molecular data classifies it in the Agaricales but, to date, with no close affiliation to any other group).

Cyathus striatus

From Alexopoulos
The Strophariaceae

- saprophytes;
- purplish / dark spores;
- often with an annulus.

*Pholiota squarrosa*

*Psilocybe cubensis*

Note the bluish tint in psilocybin-containing mushrooms, at least when bruised.

*Stropharia rugosoannulata*
Schizophyllum commune - the split-gilled mushroom

- widespread, worldwide distribution
- on wood (logs, twigs)
- used as genetic model
- Raper: mating systems

http://www.hiddenforest.co.nz/fungi/family/schizyllaceae/images/schiz01b.jpg
Phylogeography of *Schizophyllum commune*

North and Central America

Costa Rica and Colombia

South America and Caribbean

Eastern Hemisphere

Australia and Papua
New Guinea

Europe and western North America