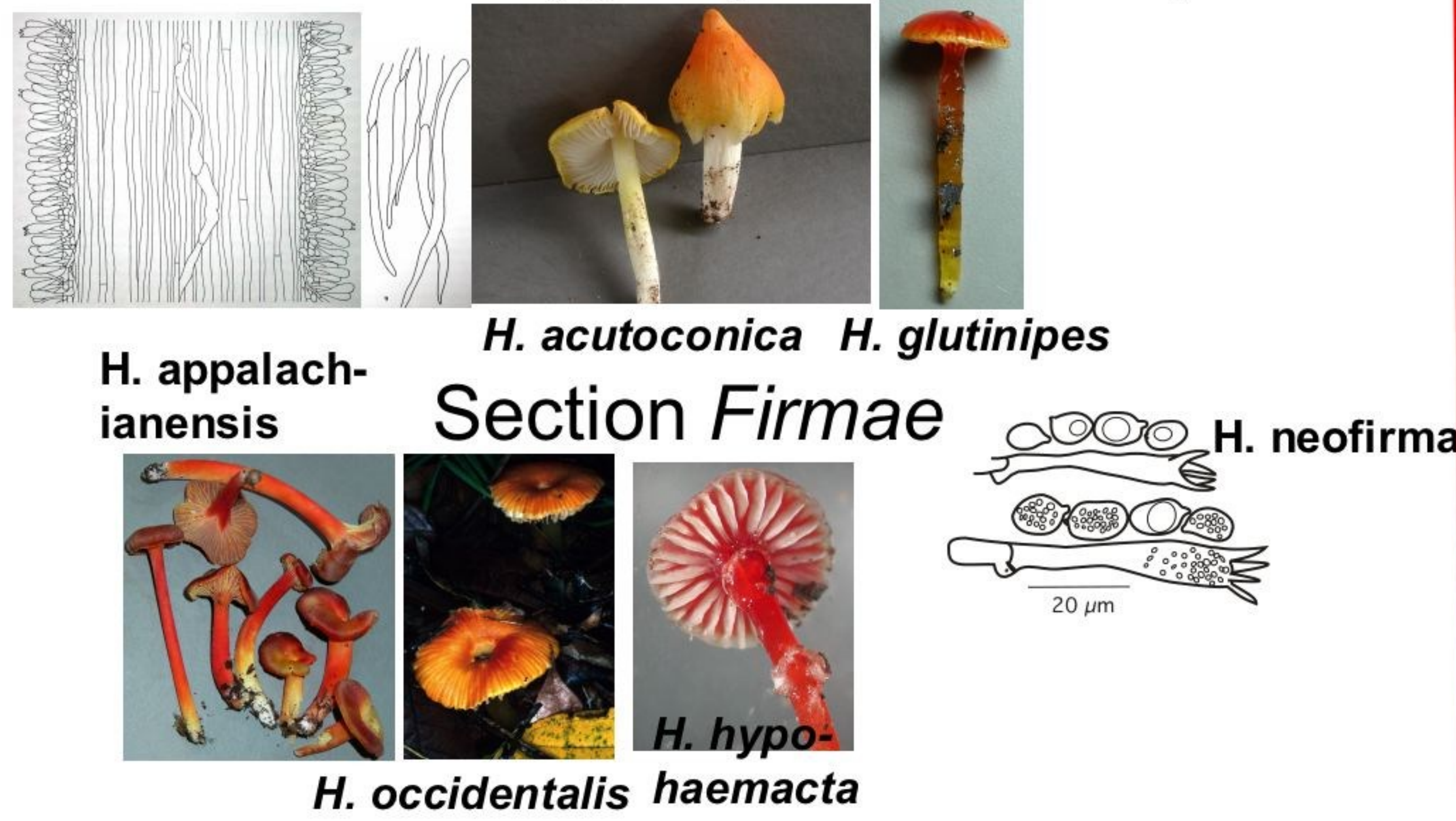# Delineating the Hygrophoraceae: Waxy Myth vs. Gene Trees

D. Jean Lodge[1], P. Brandon Matheny[2], Sharon A. Cantrell[3], Jean-Marc Moncalvo[4], Rytas Vilgalys[5] & Scott Redhead[6]

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Hygrocybe

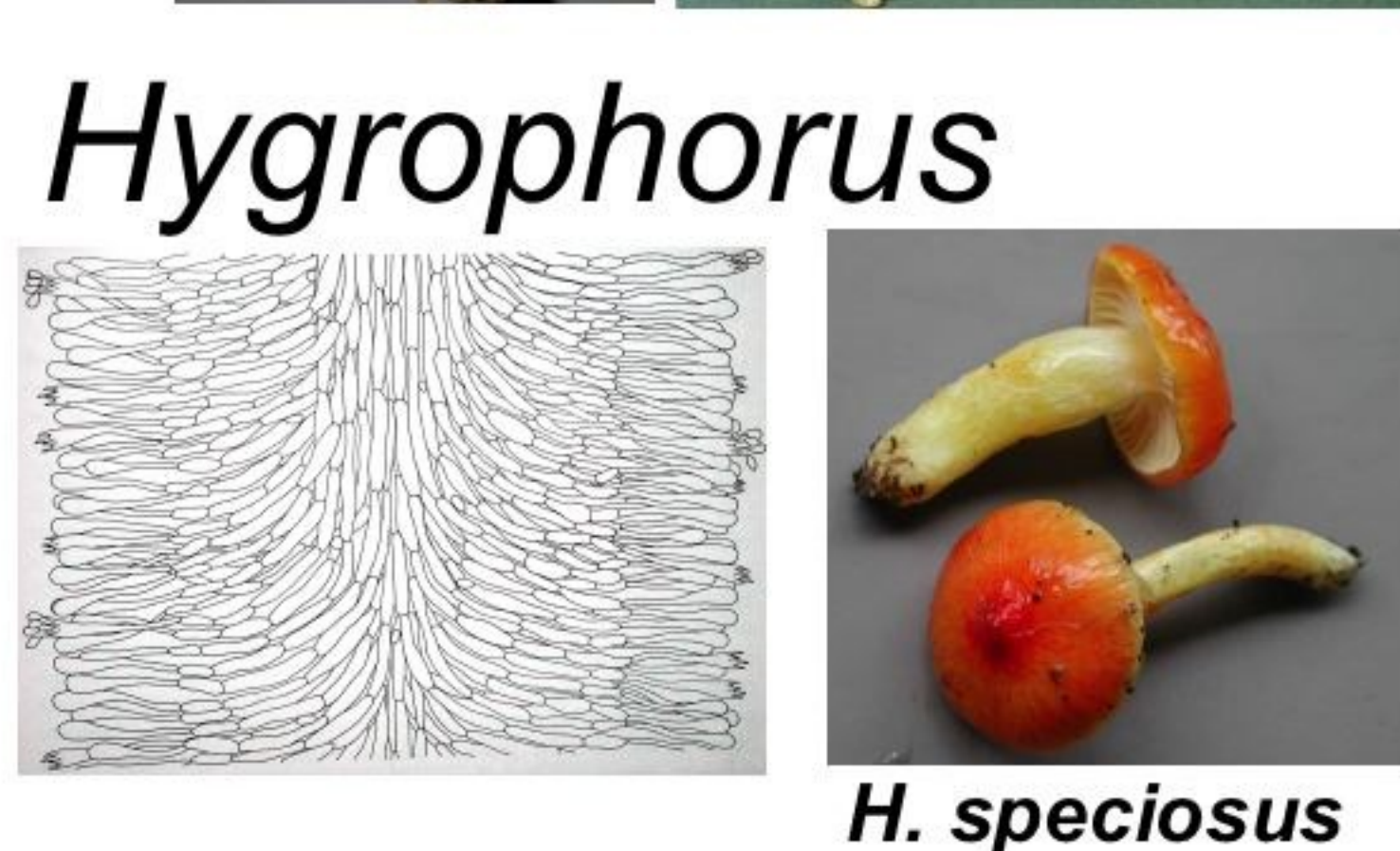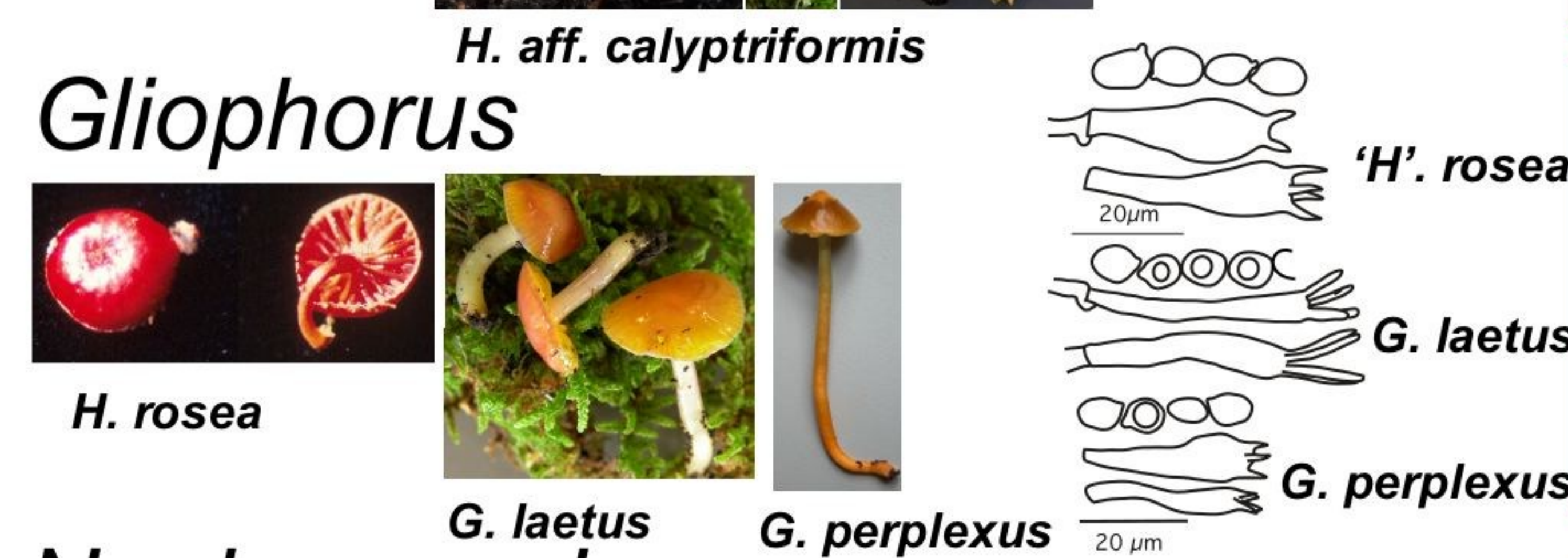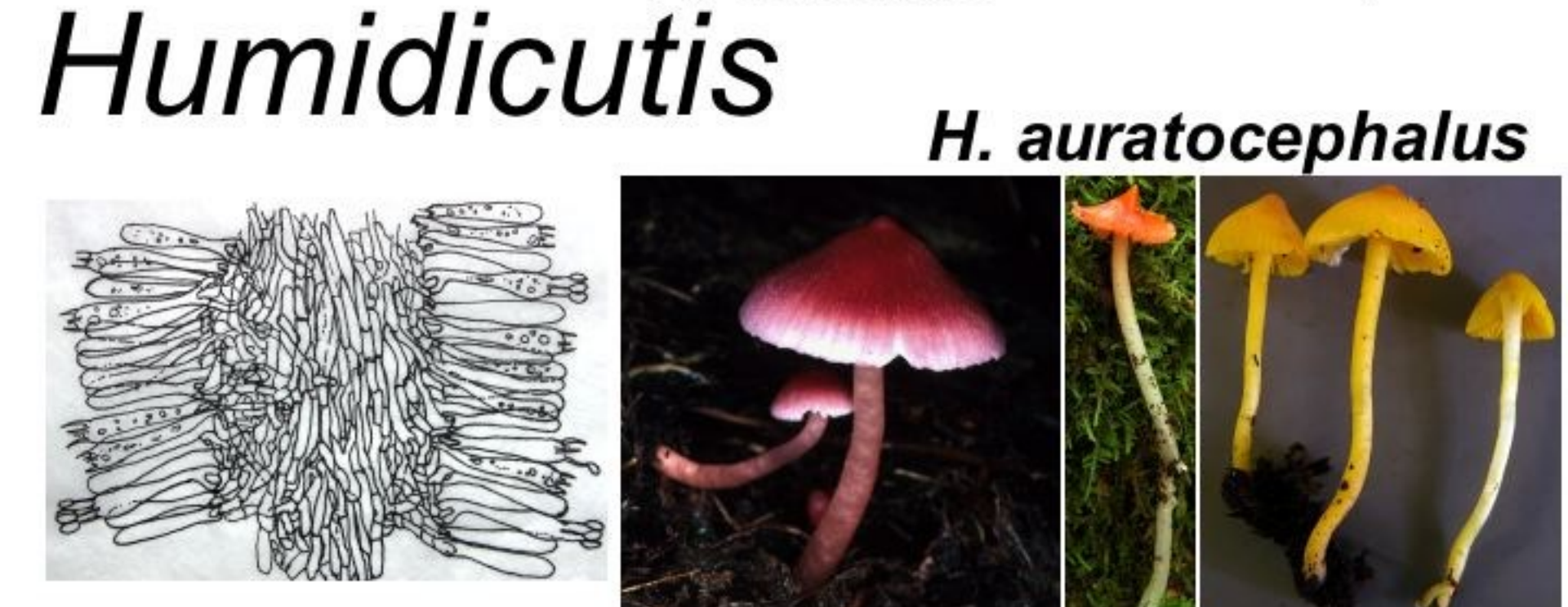Subgenus *Hygrocybe*

Sections *Hygrocybe* & *Chlorophanae*

H. appalach-ianensis   *H. acutoconica*   *H. glutinipes*

Section *Firmae*

H. neofirma

20 µm

H. occidentalis   H. hypo-haemacta

Subgenus *Pseudohygrocybe*

Section *Coccineae*

H. cantharellus

Hygroaster

H. albellus   H. nodulisporus

Humidicutis

H. auratocephalus

H. aff. calyptriformis

Gliophorus

H. rosea   G. laetus   G. perplexus

'H'. rosea   20µm

G. laetus

G. perplexus   20 µm

Neohygrocybe

Hygrophorus

H. speciosus
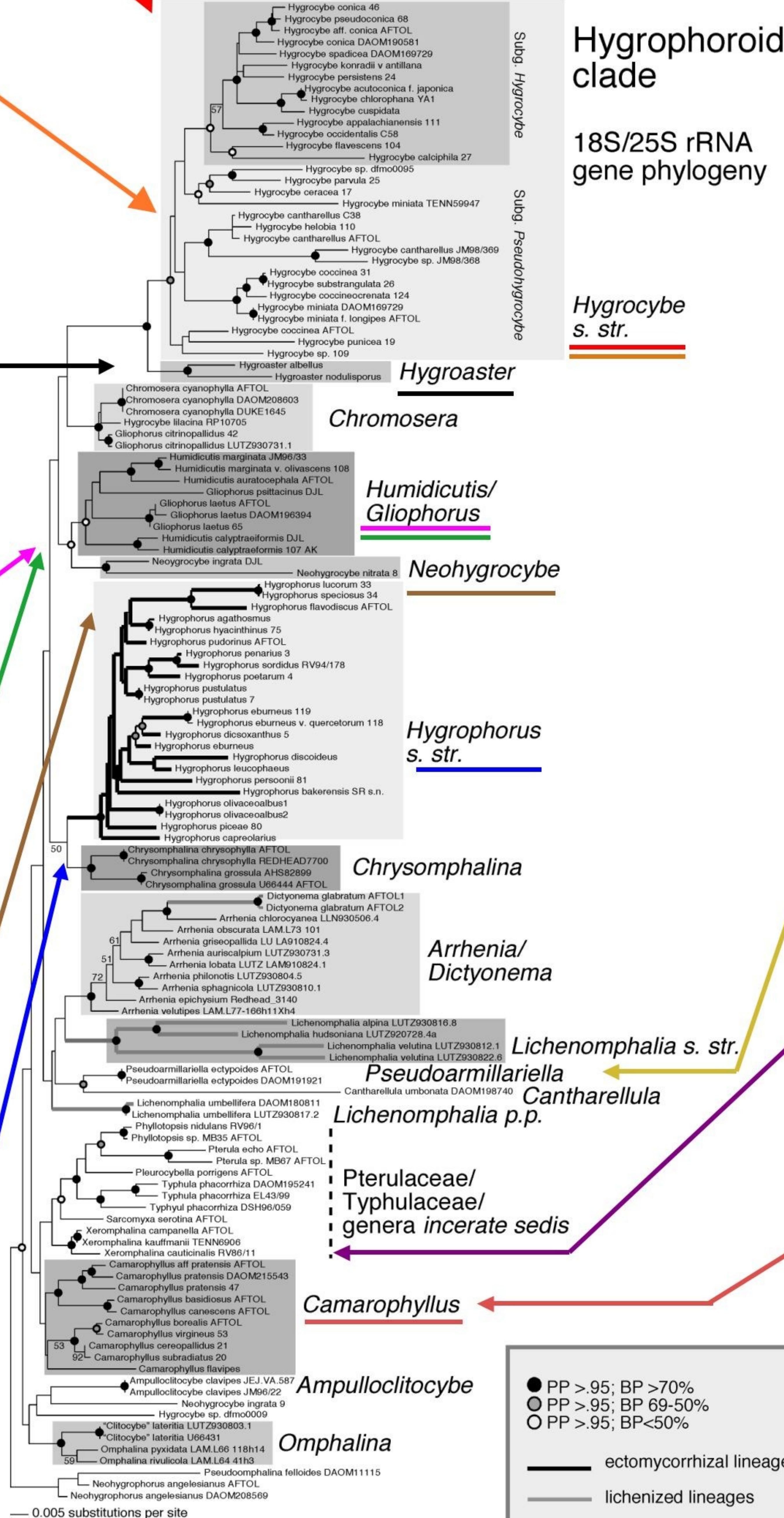
Phylogenetic trees: Maximum Parsimony with Baysian inference. 250 bootstraps were performed using SPR algorithm, 10 random addition replicates, saving one tree per replicate, and MulTrees off. Baysian analyses were conducted with Mr. Bayes 3.2.1 On a Linux cluster and run for 3 million generations, sampling trees every 500 generations. Trees sampled prior convergence were burned. A total of 8762 trees Was pooled from 2 independent runs and used to Calculate posterior probabilities.

18S & 25S Tree

Hygrophoroid clade

18S/25S rRNA gene phylogeny

Subg. *Hygrocybe*
- Hygrocybe conica 46
- Hygrocybe pseudoconica 68
- Hygrocybe aff. conica DAOM190581
- Hygrocybe conica DAOM169729
- Hygrocybe spadicea DAOM169729
- Hygrocybe konradii v antillana
- Hygrocybe persistens 24
- Hygrocybe acutoconica f. japonica
- Hygrocybe chlorophana YA1
- Hygrocybe cuspidata
- Hygrocybe appalachianensis 111
- Hygrocybe occidentalis C58
- Hygrocybe flavescens 104
- Hygrocybe calciphila 27

Subg. *Pseudohygrocybe*
- Hygrocybe sp. dfmo0095
- Hygrocybe parvula 25
- Hygrocybe ceracea 17
- Hygrocybe miniata TENN59947
- Hygrocybe cantharellus C38
- Hygrocybe helobia 110
- Hygrocybe cantharellus AFTOL
- Hygrocybe cantharellus JM98/369
- Hygrocybe sp. JM98/368
- Hygrocybe coccinea 31
- Hygrocybe substrangulata 26
- Hygrocybe coccineocrenata 124
- Hygrocybe miniata DAOM169729
- Hygrocybe miniata f. longipes AFTOL
- Hygrocybe coccinea AFTOL
- Hygrocybe punicea 19
- Hygrocybe sp. 109

Hygrocybe s. str.

- Hygroaster albellus
- Hygroaster nodulisporus

Hygroaster

- Chromosera cyanophylla AFTOL
- Chromosera cyanophylla DAOM208603
- Chromosera cyanophylla DUKE1645
- Hygrocybe lilacina RP10705
- Gliophorus citrinopallidus AFTOL
- Gliophorus citrinopallidus LUTZ930731.1

Chromosera

- Humidicutis marginata JM96/33
- Humidicutis marginata v. oliviascens 108
- Humidicutis auratocephala AFTOL
- Gliophorus psittacinus DJL
- Gliophorus laetus AFTOL
- Gliophorus laetus DAOM196394
- Gliophorus laetus 65
- Humidicutis calyptraeformis DJL
- Humidicutis calyptraeformis 107 AK
- Neohygrocybe ingrata DJL

Humidicutis/Gliophorus

- Neohygrocybe nitrata 8

Neohygrocybe

- Hygrophorus lucorum 33
- Hygrophorus speciosus 34
- Hygrophorus flavodiscus AFTOL
- Hygrophorus agathosmus
- Hygrophorus hyacinthinus 75
- Hygrophorus pudorinus AFTOL
- Hygrophorus penarius 3
- Hygrophorus sordidus RV94/178
- Hygrophorus poetarum 4
- Hygrophorus pustulatus
- Hygrophorus pustulatus 7
- Hygrophorus ebumeus 119
- Hygrophorus eburneus v. quercetorum 118
- Hygrophorus discoxanthus 5
- Hygrophorus eburneus
- Hygrophorus discoideus
- Hygrophorus leucophaeus
- Hygrophorus personii 81
- Hygrophorus bakerensis SR s.n.
- Hygrophorus olivaceoalbus1
- Hygrophorus olivaceoalbus2
- Hygrophorus piceus 80
- Hygrophorus capreolarius

Hygrophorus s. str.

- Chrysomphalina chrysophylla AFTOL
- Chrysomphalina chrysophylla REDHEAD7700
- Chrysomphalina grosula AHS82899
- Chrysomphalina grosula U06444 AFTOL

Chrysomphalina

- Dictyonema glabratum AFTOL1
- Dictyonema glabratum AFTOL2
- Arrhenia chlorocyanea LAM190506.4
- Arrhenia obscurata LAM.L73 101
- Arrhenia griseopallida LU LA910824.4
- Arrhenia lobata LAM910824.1
- Arrhenia philonotis LUTZ930804.5
- Arrhenia alpinagricola LUTZ930810.1
- Arrhenia epichysium Redhead_3140
- Arrhenia velutipes LAM.L77-166h11Xh4

Arrhenia/Dictyonema

- Lichenomphalia alpina LUTZ930816.8
- Lichenomphalia hudeoniana LUTZ920728.4a
- Lichenomphalia velutina LUTZ930812.1
- Lichenomphalia velutina LUTZ930822.6

Lichenomphalia s. str.

- Pseudoarmillariella ectypoides AFTOL
- Pseudoarmillariella ectypoides DAOM191921

Pseudoarmillariella

- Cantharellula umbonata DAOM198740

Cantharellula

- Lichenomphalia umbellifera DAOM180811
- Lichenomphalia umbellifera LUTZ930817.2

Lichenomphalia p.p.

- Phyllotopsis nidulans RV96/1
- Phyllotopsis sp. MI835 AFTOL
- Pterula echo AFTOL
- Pterula sp. MB67 AFTOL
- Pleurocybella porrigens AFTOL
- Typhula phacorrhiza DAOM195241
- Typhula phacorrhiza EL43/99
- Typhul phacorrhiza DSH96/059
- Sarcomyxa serotina AFTOL
- Xeromphalina kauffmanii TENN906
- Xeromphalina cautinalis RV86/11

Pteated (*Pteulaceae/Typhulaceae/genera incerate sedis*)

- Camarophyllus aff pratensis AFTOL
- Camarophyllus pratensis DAOM215543
- Camarophyllus pratensis 47
- Camarophyllus basidiosus AFTOL
- Camarophyllus canescens AFTOL
- Camarophyllus borealis AFTOL
- Camarophyllus virgineus 53
- Camarophyllus cereopallidus 21
- Camarophyllus subradiatus 20
- Camarophyllus flavipes

Camarophyllus

- Ampulloclitocybe clavipes AFTOL
- Ampulloclitocybe clavipes JM96/22

Ampulloclitocybe

- Neohygrocybe ingrata 9
- Hygrocybe sp. dfmo0009
- "Clitocybe" lateritia LUTZ930803.1
- "Clitocybe" lateritia U06431
- Omphalina pyxidata LAM.L66 118h14
- Omphalina rivulosa LAM.L64 41h3

Omphalina

- Neohygrophorus angelesianus AFTOL
- Neohygrophorus angelesianus DAOM208569
- Pseudoomphalina felloides DAOM11115

— 0.005 substitutions per site

Legend:
- ● PP >.95; BP >70%
- ◐ PP >.95; BP 69-50%
- ○ PP >.95; BP<50%
- ▬ ectomycorrhizal lineages
- ▬ lichenized lineages

Pseudoarmillariella

P. ectypoides

Xeromphalina

X. cf. tenuipes   Heimiomycesrheicolor

Camarophyllus

C. canescens   C. pratensis

Excluded!

Neohygrophorus & Camarophyllopsis

C. hymenocephalus