

Monographic and floristic treatments of the Inocybaceae

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OUTLINE

- A monograph of the Inocybaceae in Australia
- Prospects for North American flora (Inocybaceae)
- Molecular annotation of North American types of Agaricales



1. A monograph of the Inocybaceae in Australia



A monograph of the Inocybaceae in Australia

Scope: family level assessment across a continent, roughly same size as the U.S.

Collections: most collected by research team:

Brandon Matheny, Neale Bougher, Martin Ryberg

and collaborators:

Genevieve Gates, Roy Halling, Nigel Fechner, Tim Baroni, Sandra Abel, Jim Trappe, Teresa Lebel, Tom May

Herbaria and staff at AD, BRI, CANB, HO, MEL, PERTH

Travel and research support provided UTK, NSF

A monograph of the Inocybaceae in Australia

28 species described from Australia prior to 2010

- 5 *Auritella*
- 23 *Inocybe*

+++++

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Since 2010:

17 species accepted after type studies (Matheny & Bougher, *Muelleria* 2010)

2 introduced species documented in Western Australia (Bougher & Matheny, *Nuytsia* 2011)

4 new species described (Bougher, Matheny, & Gates, *Nuytsia* 2012)

23 accepted species of Inocybaceae from Australia as of 2012

Major challenge: Australia may contain up to 120+ species in the family

A monograph of the Inocybaceae in Australia

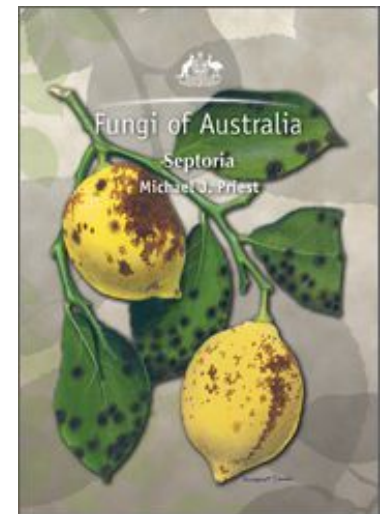
Long-term goal (within next two years) to produce descriptions, illustrations, and keys for ca. 50-60 species as volume of **Fungi of Australia** series

Support for research and to publish book by ABRS (Australian Biological Resources Study) and matching funds from The Western Australian Naturalist's Club (Perth)

Other long term goals: produce taxonomic papers of topical interest:

- secotioid forms
- trans-Tasman species
- species associated with *Allocasuarina* (Fagales)

Development of inocybaceae.org, online taxonomic resource



Data gathering

Field photos for most species

High quality line art

ITS, LSU, *rpb2* sequences

Lack sequence data from types
(most collected by J.B. Cleland
between 1917-1930)

Plan to fix application of Cleland names
to robust monophyletic groups

Descriptions are narratives, made into
composite descriptions for publications, the
Fungi of Australia volume, inocybaceae.org,
FloraBase (db of the Western Australian flora)



70

Mycologia, Vol. 22 (2) (2012)

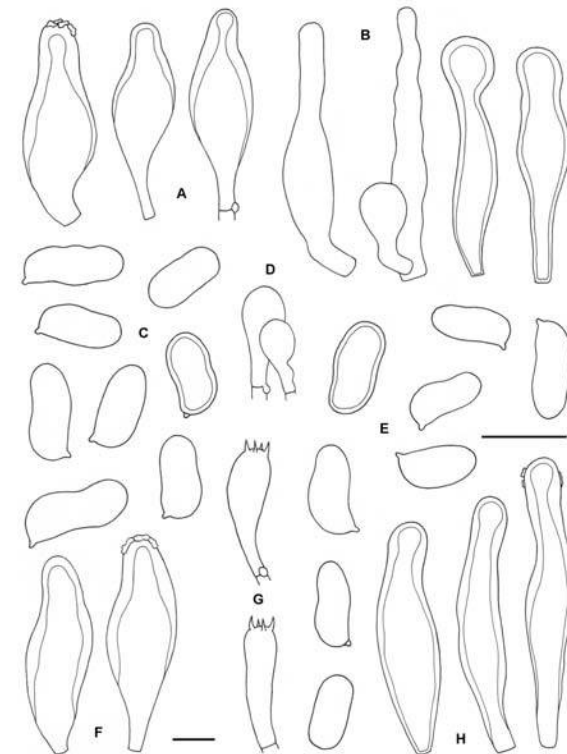


Figure 8. Micromorphology of *Inocybe sinospora* (A, D – G PERTH 07606532; B, C, H TENN 0665481. A – cheilocystidia; B – caulocystidia, caulocystidioid hairs and cauloparacystidium; C – spores; D – paracystidia; E – spores; F – pleurocystidia; G – basidia; H – pleurocystidia. Scale bars = 10 μ m (longer bar for spores only).

- Dropbox
- Sharing
- Links
- Events
- Get Started

Inocybe redolens sp nov

Search Dropbox

Name	Kind	Modified
COLLECTIONS_redolens	folder	--
DESCRIPTIONS_redolens	folder	--
EXCEL DATA_redolens	folder	--
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INOC.ORG_redolens	folder	--
MACRO IMAGES_redolens	folder	--
MICRO IMAGES_redolens	folder	--
MICRO INK DRAWINGS_redolens	folder	--
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Dropbox for Business

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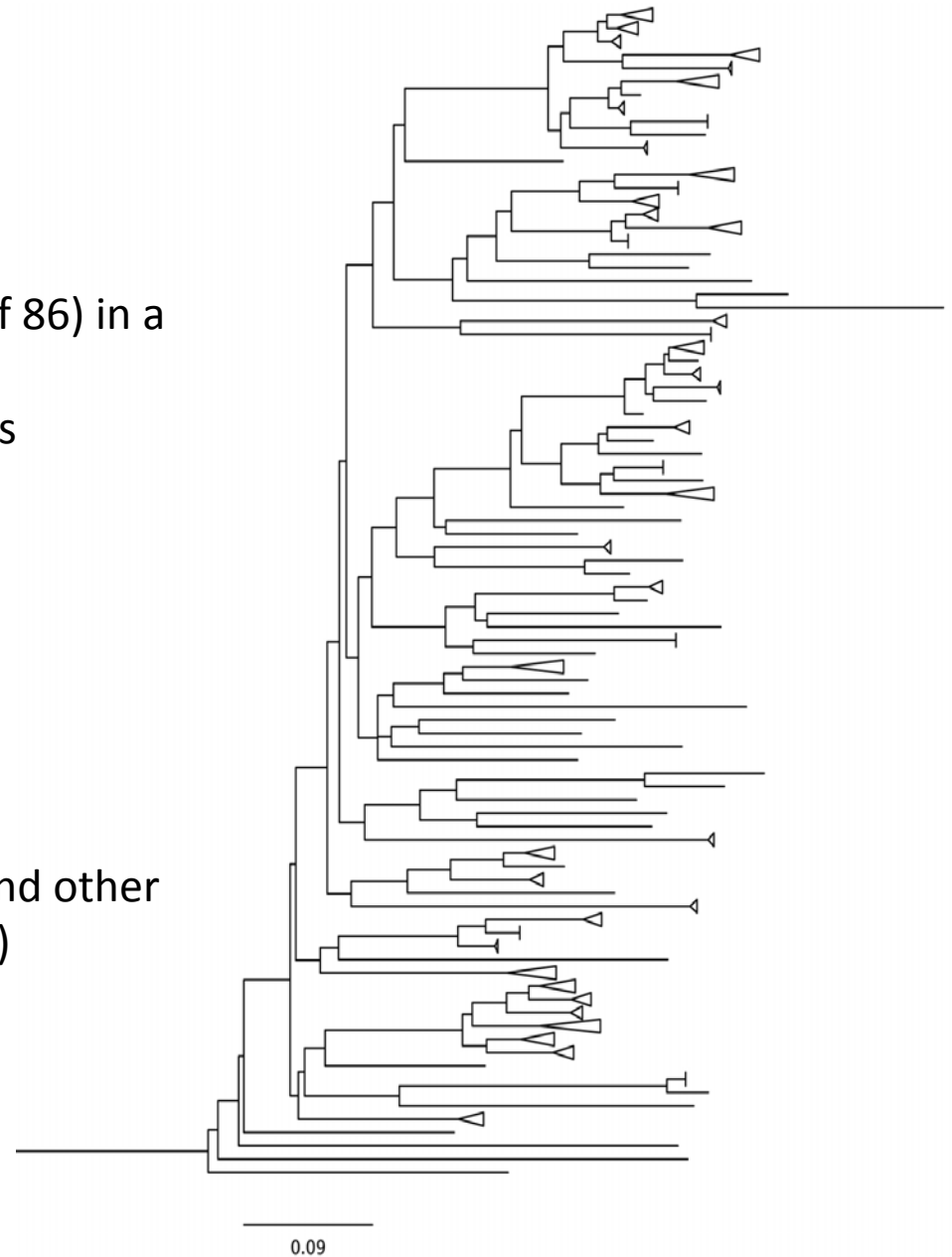
Challenges

Hyper-diversity

- 70 Australian phylogenetic species (out of 86) in a single subantarctic clade reinforced by morphological and/or ecological differences

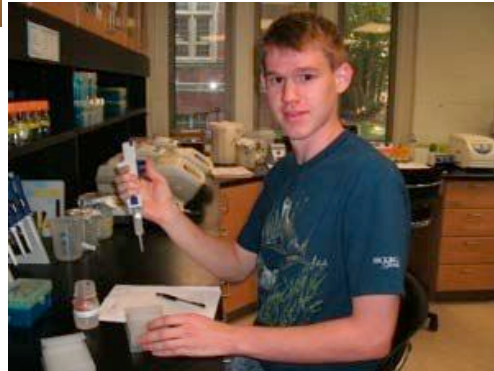
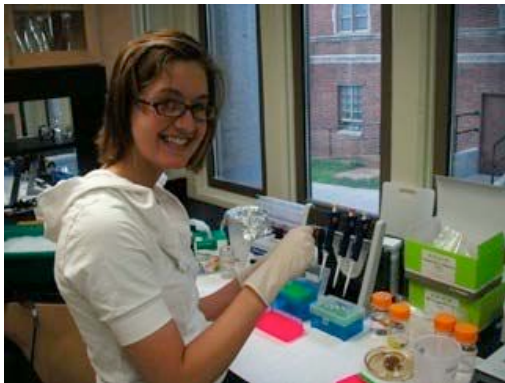
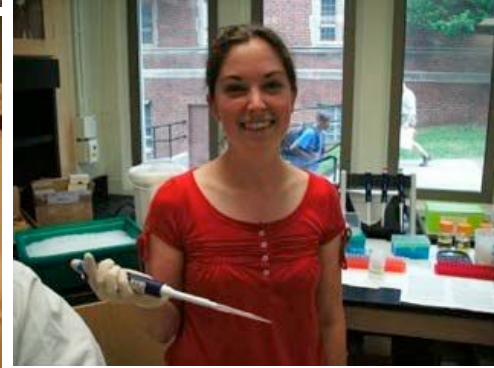
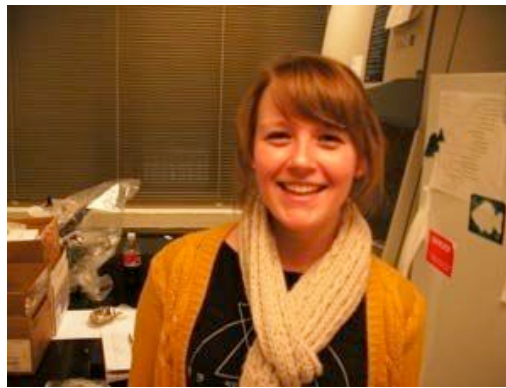
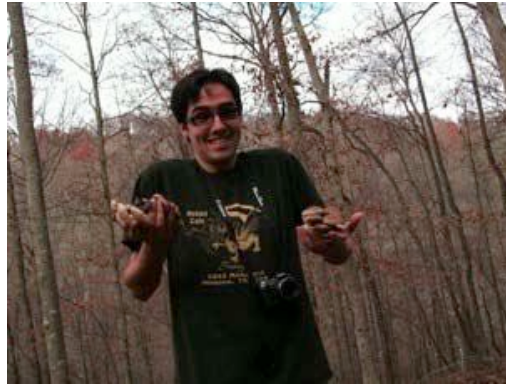
Numerous taxonomic novelties to describe

Must consider taxonomy of New Zealand and other Australasian spp (several trans-Tasman spp)



Rewards

- 8 productive undergraduates
- DNA extractions
- sequencing



2. Prospects for a North American flora (Inocybaceae)

Last monograph for NA, Kauffman (1924),
North American Flora
- 105 species treated, keys and descriptions

333 names recorded from North America
- update with current names
- sort species into artificial groups to prepare
keys



Inocybeacee_NAFlora_UPDATE.xlsx

New Open Save Print Import Copy Paste Format Undo/Redo AutoSum Sort A-Z Sort Z-A Gallery Toolbox Zoom Help

	A	B	C	D	E	F	G	H	I
	species	spores	caulocystida	pleurocystidi	current name	Containing c	References	Notes	
1	angustispora	smooth	none	no	Cortinarlius aureifolius	EXCLUDED	Bessette & Fatto 1998; Matheny & Ammirati 2003		
2	ferruginosa	verrucose	none	no	Cortinarlius uliginosus var.	EXCLUDED	Smith 1939		
3	murinollacina	smooth	no data	no data	murinollacina	EXCLUDED	Ellis & Everhart 1889	Cortinarlius per Stuntz of questionable isotype material	
4	taedophila	smooth	none	no	Cortinarlius aureifolius	EXCLUDED	Matheny & Ammirati 2003		
5	weberi	verrucose	none	no	Cortinarlius	EXCLUDED	Matheny 2003 (PhD thesis)	Cortinarlius croceus?	
6	abjecta	smooth	none	yes	abjecta	Inocybe	Grund & Stuntz 1970; Perez Silva 1967		
7	abundans	nodulose	below	yes	abundans	Inocybe	Murrill 1911; Kauffman 1924; Smith 1939; Grund & Stuntz 1984		
8	acriolens	nodulose	below	yes	acriolens	Inocybe	Grund & Stuntz 1970		
9	acuta	nodulose	none	yes	acuta sensu Kuhner & Ron	Inocybe	Grund & Stuntz 1977		
10	acystidiosa	nodulose	above	yes	acystidiosa	Inocybe	Kauffman 1924		
11	agglutinata	smooth	above	yes	agglutinata	Inocybe	Kauffman 1924		
12	alabamensis	nodulose	below	yes	paludinella	Inocybe	Kauffman 1924		
13	alachuana	nodulose	below	yes	umbratica	Inocybe	Murrill 1941; Matheny (unpublished)		
14	albodisca	nodulose	below	yes	grammata	Inocybe	Peck 1898; Kauffman 1924; Stuntz 1947; Perez Silva 1967	(as grammata); Grund & Stuntz 1980; Nishida 1989	
15	amblyspora	smooth	below	yes	amblyspora	Inocybe	Nishida 1989		
16	ammophila	smooth	above	yes	serotina	Inocybe	Atkinson (1918)		
17	angustifolia aff.	nodulose	below	yes	angustifolia aff. sensu Sing	Inocybe	Singer et al. 1983	lowland Costa Rica	
18	antillana	nodulose	below	yes	antillana	Inocybe	Pegler (1983)		
19	appendiculata	smooth	none	yes	appendiculata	Inocybe	Matheny (unpublished)	Trudell Washington material	
20	asterospora sensu Kauffman	nodulose	below	yes	asterospora sensu Kauffman	Inocybe	Kauffman 1924; Hesler 1936; Perez Silva 1967		
21	astroriana	nodulose	none	yes	curvipes	Inocybe	Murrill 1911; Smith 1939; Bougher & Matheny 2011		
22	atripes	smooth	below	yes	tenebrosa	Inocybe	Atkinson 1918; Kauffman 1924		
23	auricoma	smooth	above	yes	auricoma	Inocybe	Nishida 1989		
24	bakeri	smooth	below (above)	yes	bakeri	Inocybe	Kauffman 1924; Nishida 1989; Kropp et al. 2010	lacking metuloids at base of stp in Stuntz; near sub	
25	boltonii ssp. giacomii	nodulose	above ?	yes	giacomii	Inocybe	Miller 1987		
26	bresadolae	nodulose	below	yes	bresadolae	Inocybe	Nishida 1989		
27	brunnea	smooth	below	yes	leiocephala	Inocybe	Perez Silva 1967	High elevation; consistent with leiocephala in many	
28	brunneolipes	smooth	below	yes	brunneolipes	Inocybe	Grund & Stuntz 1970		
29	californica	nodulose	below	yes	californica	Inocybe	Kauffman 1924		
30	calospora	nodulose	below	yes	calospora	Inocybe	Kauffman 1924; Hesler 1937; Perez Silva 1967; Grund & Stuntz 1980		
31	candidipes	nodulose	below	yes	candidipes	Inocybe	Kropp & Matheny 2004		
32	castanea	nodulose	below	yes	castanea	Inocybe	Kauffman 1924; Hesler 1936; Stuntz 1947		
33	castaneoides	nodulose	none	yes	umbrina	Inocybe	Peck 1913; Kauffman 1924 (syn. of umbrina)		
34	chalcodoxantha	smooth	below	yes	chalcodoxantha	Inocybe	Grund & Stuntz 1968		
35	chelanensis	nodulose	above	yes	chelanensis	Inocybe	Stuntz 1947; Nishida 1989; Kropp & Matheny 2004		
36	chondroderma sp. nov.	smooth	above (none)	yes	chondroderma	Inocybe	Stuntz (unpublished); Matheny et al. (in prep)		
37	chrysocephala	smooth	below	yes	chrysocephala	Inocybe	Nishida 1988; Nishida 1989	Close to kauffmani	
38	cicatricata	nodulose	none	yes	cicatricata	Inocybe	Ellis & Everhart 1889; Kauffman 1924; Hesler 1936; Stuntz 1947; Perez Silva 1967		
39	cinninata	smooth	none	yes	cinninata	Inocybe	Kauffman 1924; Perez Silva 1967		
40	cinninatula	smooth	none	yes	cinninata	Inocybe	Grund & Stuntz 1968		
41	cinnamomea	smooth	above (extreme)	yes	cinnamomea	Inocybe	Nishida 1989		
42	comatella	smooth	below	yes	comatella	Inocybe	Peck 1885; Kauffman 1924; Matheny (unpublished)		
43	connexa	smooth				Inocybe	Kauffman 1924		
44	corydalina	smooth	above	yes	corydalina	Inocybe	Kauffman 1924; Nishida 1989		
45	crassicyclidiata	nodulose	below	yes	crassicyclidiata	Inocybe	Pegler (1983)		
46	cryptocystis	smooth	above	yes	cryptocystis	Inocybe	Stuntz 1954; Grund & Stuntz 1983	Also reported in Europe (Kuyper 1986)	
47	cylindrocystis	smooth	above	yes	cylindrocystis	Inocybe	Atkinson 1918; Kauffman 1924	Very close, if not same, as cryptocystis	
48	cylindrospora	smooth	above	yes	cylindrospora	Inocybe	Murrill 1945; Stuntz (unpublished); Matheny (unpublished)	Stirps Cylindrospora; near longispora	
49	davisi	nodulose	below?	yes		Inocybe	Kauffman 1924; Smith 1939		
50	decipiens	nodulose	below	yes	decipiens	Inocybe	Kauffman 1924; Nishida 1989		
51	decipitoides	nodulose	none	yes	curvipes	Inocybe	Peck 1907; Kauffman 1924; Stuntz 1947		
52	descissa var. macrospora	smooth	above	yes	descissa var. macrospora	Inocybe	Stuntz 1954	Alessio (1980) as I. macrospora comb. nov.	

North American flora (Inocybaceae), an exercise

Kauffman (1924), *North American Flora*
- 4 species treated in sect. *Cervicolores*
(*Inosperma*)

12 species now recognized

Type studies, two types sequenced:
I. apiosmota Grund & D.E. Stuntz,
I. mucidiolens Grund & D.E. Stuntz

Keys and descriptive part
in prep



Inocybaceae of North America, an exercise

Taxonomic key

KEY TO SPECIES OF SECTION *CERVICOLORES* (INOSPERMA CLADE, *INOCYBE SENSU LATO*) FROM NORTH AMERICA

- 1a. Stipe surface fibrillose, with loose fibrils, or fibrillose-streaked..... 2
- 1b. Stipe surface with recurved scales or fibrillose-scaly 5

- 2a. Fruitbodies small, pileus 3-4 mm, stipe 20-30 × 1 mm, known only from the type in New York.....
..... *I. tenerrima* G.F. Atk.
- 2b. Fruitbodies medium-sized to robust, pileus >10 mm and stipe >1 mm, known more widely from eastern North America or Alaska 3

- 3a. Odor spermatic, known only from Nova Scotia *I. hirsuta* sensu Grund & Stuntz
- 3b. Odor not spermatic 4

- 4a. Pileus with fine reddish fibrils, fruitbodies small, pileus <30 mm wide, stipe <30 mm long, associated with *Salix* in Yukon and Alaska, odor not recorded.....
..... *I. bongardii* (Weinm.) Quél. sensu O.K. Miller
- 4b. Pileus with russet brown coarse scales, fruitbodies larger than above, pileus 15-45 mm wide, stipe >30 mm long, associated with stands of mixed hardwoods or in stands with *Tsuga* in eastern North America.
..... *I. cervicolor* (Pers.: Fr.) Quél. (= *I. subrunescens* G.F. Atk.)

- 5a. Odor like ripe pears..... *I. apiosmota* Grund & D.E. Stuntz
- 5b. Odor fishy, like *Pelargonium*, or green corn..... 6

- 6a. Fruitbodies large, stipe 55-120 × 6-14 mm long, odor fishy or fishy mixed with *Pelargonium*..... 7
- 6b. Fruitbodies medium, stipe 20-85 × 2.5-5 mm, odor as above or like green corn..... 9

- 7a. In high-elevation *Quercus* forests of Costa Rica *I. aff. calamistrata* group II
- 7b. In conifer forests of temperate regions 8

- 8a. Pileus with reddish brown scales against pale brown to light yellowish brown ground color, green sometimes absent from stipe base, spores 9-11 × 5-6 μm.....
..... *I. maxima* (A.H. Sm.) Matheny, comb. nov.



DESCRIPTIVE PART

Inocybe apiosmota Grund & D.E. Stuntz, *Mycologia* 67: 21. 1975.

Pileus 20-35 mm, convex expanding with broad umbo, disc squarrose, margin lacerate-fibrillose, reddish brown or Argus Brown (6E7), context buff, *odor aromatic of pears*. Lamellae adnate, subdistant, Argus Brown, broad. Stipe 40-55 × 3-4 mm, equal, slightly enlarged below, surface *densely and coarsely squarrose*, apex fibrillose, Raw Umber, context hollow, buff with slight greenish cast. Spores 10-12 × 5.5-6.5 μm, mostly 11 × 6 μm from 4-sterigmate basidia, larger 13-14.5 × 6.5-8 μm from 2-sterigmate basidia, phaseoliform. Basidia 2- and 4-sterigmate. Pleurocystidia none. Cheilocystidia 40-50 × 12-17 μm, clavate, thin-walled, brown.

TYPE LOCALITY: Waterville Mountain, Kings County, Nova Scotia (AU10560). Type sequences: HQ201336 (ITS), JN975022 (nLSU-rRNA).

HABITAT: Host vegetation includes *Tsuga*, while the type is recorded from a “swamp”, July to September.

DISTRIBUTION: Widely distributed in eastern North America—Nova Scotia, Pennsylvania, east Tennessee but rarely recorded.

ILLUSTRATIONS: Grund & Stuntz, *Mycologia* 67: 21 (1975).

NOTES: The description above is from the protologue. I have encountered this species in Pennsylvania and east Tennessee but missed examination for the pear-like odor. If a consistent feature, the dimorphic spores might also be a diagnostic. Data on whether the context is rubescent is lacking. The species is not very well known but is widespread in eastern North America and probably misinterpreted as *I. calamistrata*.

Inocybe atrovirescens Matheny, sp. nov.

Pileus 25-40 mm, conical to plano-convex, densely matted fibrillose, with recurved squamules in age, grayish brown to brown or Saccardo's Umber (5D4-D5D-5E5), context thick, odor strong like trout or fish. Lamellae adnate to subdistant, close, light brown to brown (5D5-5E6) with olive green tinge on gills.

3. Molecular annotation of type specimens from North America: pilot study

Sampled 97 types of Agaricales (TENN, WTU)
Clavaria, *Clitocybe*, *Clitopilus*, *Crepidotus*,
Cystoderma, *Entoloma*, *Gymnopilus*, *Hebeloma*,
Hygrophorus, *Inocybe*, *Pholiota*, *Ramariopsis*,
Rhodocybella

- 80 complete or partial ITS sequences (82%)
 - 66 collections >40 yrs old, oldest 75 yrs old
 - 46 (58%) are novel seqs on GenBank
 - 12 match insufficiently identified seqs

Selected LSU-rRNA sampling (LR0R-LR16/LR5)

105 sequences from types produced
(released on GenBank)



Other monographic works at UTK

-Clavariaceae in the Pacific Northwest
-*Camarophyllopsis*, *Hodophilus*, global
Joshua Birkebak, PhD student

-Leucopaxilleae (Tricholomataceae)
Leucopaxillus, *Porpoloma*, *Dennisiomyces*
Marisol Sanchez Garcia, PhD student

-*Auricularia* of the southeast United States
Brian Looney, PhD student



“The best way to know what a species is... is to know what it is”

J.F. Ammirati