

Appendix 12: Draft Key to *Amanitaceae* of Costa Rica & Neighboring Regions (with Emphasis on Species from Forests Including *Quercus*)

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LIMACELLA

Only one species of *Limacella* is known from Costa Rica; apparently, it is *Limacella glischra* (Morgan) Murr. It is a small mushroom with a slimy red-brown pileus and a stipe, slimy below an obscure annular zone with reddish brown tints and/or fibrils to the stipe gluten. The sole known collection is from Hacienda La Amistad, Canton Coto Brus, Puntarenas Province.

AMANITA

Key to the Sections of the Genus *Amanita*

We recognize the supraspecific taxa of *Amanita* accepted by Corner and Bas (1962) and by Bas (1969). A key to the sections of the genus is to be found in Bas (1969), Jenkins (1986), and Tulloss *et al.* (1992). The sectional key from Bas (1969) is reproduced here for the convenience of the reader with a few additions (in *italics*) in the sixth and seventh couplets.

1. Spores amyloid. Margin of pileus rarely radially sulcate. Lamellulae often attenuate.....
subgenus *Lepidella*.
2. Universal veil pulverulent or breaking up into flocks, warts, scales, patches, belts or crusts on pileus and stipe; sometimes disappearing completely from base of stipe. If bulb of stipe marginate, then universal veil floccose or forming conical warts, at least at center of pileus, and never provided with (sub)membranous outer layer.
3. Margin of pileus not appendiculate. Pileipellis often deeply colored. Spores globose to ellipsoid, mostly < 10 µm, rarely up to 12 µm long. Partial veil membranous, rarely fugacious.....
section *Validae*.
3. Margin of pileus appendiculate. Pileipellis rarely deeply colored. Spores globose to bacilliform, rather often > 10 µm long. Partial veil membranous to friable.....
section *Lepidella*.
2. Universal veil circumscissile, limbate or saccate.
4. Universal veil circumscissile or limbate, breaking up into submembranous, rarely pulverulent or floccose patches on pileus and leaving a slight, (sub)membranous limb or fragments of a limb at base of stipe, or else bulb distinctly marginate. Remnants of universal veil never conical warts.
5. Margin of pileus appendiculate. Spores broadly ellipsoid to bacilliform. Partial veil membranous, friable or fugacious.....
section *Lepidella*.
5. Margin of pileus not appendiculate. Spores globose to subglobose. Partial veil membranous.....
section *Phalloideae*.
4. Universal veil saccate, forming a membranous sac at base of stipe and only occasionally one or a few membranous patches on pileus; but sometimes inner layer of universal veil friable and forming scales, patches or powder on pileus.

- 6. Pileipellis often distinctly colored, *usually with nonstriate margin*. Spores globose to ellipsoid, or infrequently cylindric or bacilliform (in < 10% of known taxa). Partial veil membranous. Universal veil without friable inner layer. Lamellae not strongly darkening *after slow drying*.
section *Phalloideae*.
- 6. Pileipellis usually white to brownish, *often with striate margin*. Spores *predominantly* broadly ellipsoid to bacilliform, *but subglobose in one taxon*. Partial veil often friable. Universal veil sometimes with friable inner layer. Lamellae often darkening strongly *when specimens are dried slowly*.
section *Amidella*.
- 1. Spores inamyloid. Margin of pileus mostly radially sulcate. Lamellulae nearly always truncate.
subgenus *Amanita*.
- 7. Stipe with bulbous base. Universal veil usually friable, sometimes limbate.
section *Amanita*.
- 7. Stipe without bulbous base. Universal veil usually saccate, *occasionally* friable.
section *Vaginatae*.

Subgenus *AMANITA*

Section *AMANITA*

- 1. Pileus brilliant red to orange-red at first, fading to pale brownish orange or yellowish tan; universal veil yellow at first, fading to pale, sordid buff, in rings and broken rings on lower stipe and upper part of basal bulb; spores (7.5-) 9.0 - 12.9 (-19.0) × (5.5-) 6.5 - 8.6 (-11.5) μm, with **Q** = (1.29-) 1.31 - 1.54 (-1.95).
Amanita muscaria subsp. *flavivolvata* Singer.
- 1. Pileus some shade of yellow, brown, or gray; universal veil ocreate, limbate, pulverulent, or (occasionally) scant.
 - 2. Pileus brownish gray with concolorous pulverulent universal veil; stipe exannulate from “button” stage; universal veil on bulb of stipe as appressed pulverulence; spores (6.0-) 6.5 - 8.8 (-10.5) × (5.2-) 5.5 - 7.2 (-9.0) μm, with **Q** = 1.15 - 1.23.
Amanita farinosa Schwein.
 - 2. Pileus some shade of yellow or brown; stipe annulate at least in young material; universal veil not pulverulent.
 - 3. Pileus dull yellow to cream yellow; universal veil at stipe base scant or as detersile limb, white at first, gray-ing with age; subhymenial base containing elongate inflated cells at shallow angle to central stratum and very similar to intercalary inflated cells of central stratum; $w_{st-near} = 15 - 30 \mu m$; $w_{st-far} = 25 - 45 \mu m$; spores (6.2-) 8.0 - 10.2 (-12.2) × (5.2-) 7.2 - 9.5 (-10.8) μm, with **Q** = 1.05 - 1.11 (-1.15).
Amanita xyliniolva Tulloss *et al.*
 - 3. Universal veil on stipe base ocreate at least in young specimens, occasionally fragmented in older ones, never as triangular limb. (See also *Amanita xyliniolva*, below.)
 - 4. Pileus lemon yellow to tannish yellow to yellow-tan over disc; universal veil at stipe base often strongly ocreate in young specimens; subhymenial base with plentiful clavate to broadly clavate, divergent inflated cells at angles of up to 45° or more to central stratum; $w_{st-near} = 65 - 70^+ \mu m$; $w_{st-far} = 80 - 85^+ \mu m$; spores (8.2-) 8.8 - 10.8 (-12.0) × (7.0-) 7.2 - 9.1 (-10.6) μm, with **Q** = 1.19 - 1.24.
Amanita sp. *HON2*.
 - 4. Pileus dark brown at first, fading to buff; universal veil ocreate; spores [from specimen with damaged stipe, may be smaller than average] (8.3-) 8.7 - 10.5 (-11.5) × (6.0-) 6.5 - 8.0 (-8.6) μm, with **Q** = 1.32 - 1.35.
Amanita sp. *HON9*.

Section *VAGINATAE* (Fr.) Quél.

1. Universal veil fragile to friable, becoming grayish or fuscous to reddish brown rather rapidly, absent or cupulate at stipe base.
2. Pileus gray over disc, paler toward margin, occasionally with dark gray remnants of universal veil; universal veil on stipe as gray patches and white, cupulate volva with brief limb; spores (9.0-) 9.1 - 10.5 (-15.7) × (7.2-) 8.0 - 9.0 (-13.9) μm, with **Q** = 1.18; known from elevations below 1400 m with *Pinus oocarpa*.
Amanita sp. HON11.
2. Spores with **Q** ≤ 1.15; known from elevations above 1600 m with *Quercus spp.*
3. Pileus dull olive-brownish gray to grayish; universal veil becoming fuscous to reddish brown; spores (9.0-) 10.0 - 12.8 (-14.5) × (8.5-) 9.5 - 12.2 (-14.0) μm, with **Q** = 1.03 - 1.05.
Amanita colombiana Tulloss *et al.*
3. Pileus brownish gray to very dark brown; subhymenium having $w_{st-near} = (5-) 15 - 45 (-50) \mu m$ and $w_{st-far} = (25-) 35 - 70 \mu m$, pseudoparenchymatous; universal veil as small cup on stipe base and patches or complete ring (often nearly black in exsiccata) on lower stipe, becoming gray to brownish gray or darker with exposure; spores (7.8-) 9.5 - 14.0 (-17.0) × (7.2-) 8.8 - 12.8 (-15.5) μm, with **Q** = 1.05 - 1.11 (-1.15).
Amanita sororcula Tulloss *et al.*
=*Amanita inaurata sensu* Singer.
1. Universal veil submembranous and saccate and graying only in upper portion or neither graying, nor becoming fuscous or reddish brown and then membranous, cupulate to saccate, persistent and (except in *Amanita sp. CR4*) remaining attached to stipe.
4. Stipe annulate.
5. Pileus 35[±] - 90 mm wide, pale beige-brown (pinkish brown) over disc, paler at margin, pigment (at least sometimes) not evenly distributed; stipe white, lacking colored patches; universal veil cupulate, not thick; spores (10.0-) 10.2 - 13.2 (-13.8) × (5.8-) 6.5 - 7.8 (-8.2) μm, with **Q** = 1.62 - 1.72.
Amanita belizeana Tulloss *nom. prov.*
5. Pileus more intensely pigmented (brown to umbrinous brown to olive brown to orange-brown to red-brown at least over disc); ??.
6. Pileus olive brown to orange-brown to red-brown over disc, otherwise various shades of yellow to orangish yellow to yellowish brown; stipe yellow to buff, with ochraceous to dull brownish orange to orange-brown floccose to fibrillose scales; spores (7.5-) 7.8 - 11.0 (-12.5) × (5.7-) 6.2 - 7.8 (-9.3) μm, with **Q** = 1.25 - 1.28.
Amanita garabitoana Tulloss *et al. nom. prov.*
6. Pileus umbrinous brown over disc, paler toward margin; stipe with off-white to pale cream ground color; spores ??.
Amanita sp. CR13.
4. Stipe exannulate.
7. Pileus grayish brown to gray or having dark (somewhat reddish) brown disc with remainder brown to gray-brown; spores with **Q** ≥ 1.17.
8. Universal veil becoming gray in upper part of limb, leaving thin gray patches on pileus during expansion; pileus dark grayish brown over disc to nearly white over marginal striations; 10.0 - 12.0 (-13.0) × (8.5-) 8.7 - 10.0 (-12.4) μm, with **Q** = 1.17.
Amanita sp. CR16.
8. Universal veil not becoming gray in upper part of limb (may bruise buff in that region).
9. Pileus gray; universal veil at stipe base easily removed from stipe after maturity; spores 9.5 - 11.2 (-13.5) × (7.0-) 7.2 - 8.8 (-9.2) μm, with **Q** = 1.29.
Amanita sp. CR4.

9. Pileus dark (somewhat reddish) brown over disc, otherwise brown to gray-brown; universal veil as robust, persistent, membranous, saccate volva, white, bruising buff; spores 10.1 - 11.6 (-13.7) × (8.5-) 8.7 - 10.0 μm, with $Q = 1.19$
Amanita sp. CR2.
7. Pileus of various colors; universal veil saccate, not easily removed from stipe; spores with $Q \leq 1.15$.
10. Pileus yellowish; spores (10.1-) 10.5 - 12.0 (-12.5) × 9.5 - 11.0 (-12.1) μm, with $Q = 1.06$
Amanita sp. CR9.
10. Pileus gray-buff with olive-brown disc or orange-brown or fulvous or brown to fuliginous and often with very dark disc.
11. Pileus gray-buff toward margin, with olive-brown disc; subhymenial tree comprising mostly elongate(22) elements; spores (10.3-) 10.8 - 13.1 (-15.5) × (9.5-) 9.8 - 12.0 (-14.0) μm, with $Q = 1.10$; known from pure stand of *Pinus oocarpa*, 1200 - 1300 m elev.
Amanita sp. HON8.
11. Pileus orange-brown or fulvous or brown to fuliginous, often with very dark disc; subhymenial tree comprising mostly ovoid to ellipsoid to subglobose to globose elements interwoven with branching, filamentous, undifferentiated hyphae; spores (7.5-) 9.0 - 12.0 (-15.5) × (6.5-) 8.4 - 11.2 (-15.0) μm, with $Q = (1.05-) 1.06 - 1.12 (-1.15)$; known only in association with *Quercus*, 1500 - 2900 m elev. in region of study.....
Amanita fuliginodisca Tulloss *et al.*

Subgenus *LEPIDELLA* (E.-J. Gilbert) Veselý *emend.* Corner & Bas

Section *LEPIDELLA*

1. Pileus pinkish buff; universal veil on pileus in tightly appressed patches, white to concolorous, comprising outer layer of interwoven filamentous, undifferentiated hyphae and interior dominated by chains of narrow, relatively large inflated cells with periclinal orientation, pileipellis poorly developed; spores (7.8-) 8.2 - 10.0 (-10.5) × (5.5-) 6.0 - 7.0 (-8.0) μm, with $Q = 1.34 - 1.39$ (*Amanita* subsect. *Vittadiniae* Bas).....
A. species HONI.
1. Universal veil as warts or irregular patches or as pyramidal warts; elements comprising these warts with elements disordered or having more or less anticlinal orientation, never as chains of relatively large, narrow inflated cells with strong periclinal orientation.
2. Outer layer of volva consisting mainly of hyphae; consequently, often with small, incomplete volval limb on stipe's basal bulb; lamellae ochraceous to yellow to pale orange. (*Amanita* subsect. *Gymnopodae* Bas)
3. Spores (7.8-) 8.1 - 10.0 (-11.5) × (5.3-) 6.0 - 7.5 (-8.7) μm, with $Q = 1.33 - 1.41 (-1.44)$; found between 1600 - 1720 m elev. in Prov. Cartago with *Q. oocarpa* and *Q. seemanii*.
A. conara Tulloss *et al. nom. prov.*
3. Spores (6.1-) 7.0 - 9.5 (-11.6) × (5.1-) 6.9 - 7.9 (-9.5) μm, with $Q = (1.11-) 1.15 - 1.23$; found between 1350 - 1500 m elev. in Prov. Puntarenas with *Q. corrugata* and *Q. seemanii*.
A. species CR18.
2. Volva never submembranous, never forming limb at base of stipe; lamellae never ochraceous (*Amanita* subsect. *Solitariae* Bas).
4. Pileus rat gray to brown, micaceous gray to pallid in age or after rains wash away pigment, with brownish gray pulverulent universal veil remains in pyramidal warts or irregular patches, often darker than pileipellis; bulb of stipe napiform, often markedly radicating; spores (7.5-) 8.5 - 13.2 (-16.0) × (5.1-) 6.0 - 8.5 (-12.6) μm, with $Q = 1.35 - 1.68 (-1.70)$
A. costaricensis Tulloss *et al. nom. prov.*
4. Pileus and universal veil white, at least at first.
5. Much of basidiome staining ochraceous buff to rust colored to chestnut brown or yellow to cinnamon; universal veil on pileus as flattened to slightly erumpent large warts or small patches; all parts of basidiome liable to

staining pale yellowish and, eventually, cinnamon; bulb of stipe napiform, never abrupt or subabrupt, decorated with narrow rings of volval tissue beginning on lower stipe above bulb and continuing to approximately broadest part of bulb; spores (8.5-) 9.0 - 12.5 (-14.0) × (6.5-) 7.0 - 9.5 (-10.2) μm, with **Q** = 1.29 - 1.32.

A. advena Tulloss *et al.*

5. Pileus not staining, often covered rather densely by minute pyramidal warts; bulb slenderly subnapiform to napiform, subradicating, with either rings of flocculence or minute pyramidal warts around the top of the bulb; spores (7.0-) 9.1 - 13.0 (-17.5) × (5.2-) 5.9 - 7.8 (-9.5) μm, with **Q** = (1.35-) 1.50 - 1.81.

A. polypyramis (Berk. & Curt.) Sacc.

Key for Section *AMIDELLA* (E.-J. Gilbert) Konrad & Maubl.

There is only one species in this section known from the region of study. It is tentatively called *Amanita sp. CRI*. The collection reported here is the southernmost collection of any taxa in the present section in the Western Hemisphere.

Key for Section *PHALLOIDEAE* (Fr.) Quél.

1. Pileus white to smoke gray; spores (7.0-) 8.0 - 11.0 (-12.0) × (4.8-) 5.2 - 6.5 (-7.5) μm, with **Q** = 1.50 - 1.66; associated with *Pinus* at 500 - 1100 m elev.

Amanita eburnea Tulloss.

1. Pileus white or grayish brown or brownish gray; spores with **Q** < 1.25; associated with *Quercus* and occurring with *Quercus* in mixed broadleaved cloud forest at 1900 - 2350 m elev.

2. Pileus white; spores (8.0-) 8.1 - 10.0 (-11.0) × 7.1 - 8.9 (-9.4) μm, with **Q** = 1.12 - 1.19.

Amanita sp. HON6 (cf. *A. bisporigera* G. F. Atk.).

2. Pileus grayish brown or brownish gray, usually distinctly virgate; spores (5.8-) 7.0 - 10.0 (-12.8) × (5.5-) 6.8 - 9.5 (-12.0) μm, with **Q** = 1.04 - 1.08 (-1.10).

Amanita arocheae Tulloss *et al.*

Key for Section *VALIDAE* (Fr.) Quél.

1. Basidiocarp bruising reddish brown in all parts; stipe with dark fibrils over pallid to wine-stained ground color; universal veil material becoming very dark brown with age; spores (6.5-) 7.5 - 10.0 (-12.5) × (5.0-) 5.8 - 7.8 (-9.0) μm, with **Q** = 1.27 - 1.34 (-1.36).

Amanita brunneocularis Tulloss *et al.*

1. Basidiocarp not bruising reddish brown in any part; stipe white to yellow to orange; volval material pale yellow to yellow to orange.

2. Stipe lacking an abrupt or marginate bulb.

3. Pileus dark brown; basidiocarp sometimes with odor of chlorine; spores 22 μm, with **Q** = ??.....

Amanita sp. ??.

3. Pileus brownish orange to orange-brown or, when exposed to sun at high altitudes, mustard or sordid yellow; lacking any distinctive odor; spores (5.2-) 6.8 - 9.0 (-11.5) × (4.5-) 5.8 - 7.5 (-9.5) μm, with **Q** = (1.12-) 1.14 - 1.28.

Amanita flavoconia var. *inquinata* Tulloss *et al.*
= *Amanita flavoconia* var. *sinapicolor* Tulloss *et al.*

(Also, see *Amanita sp. HON10*).

2. Pileus shades of citrin, umbrinous citrin, olive, gray, gray-brown, and brown; bulb of stipe abrupt; universal veil at stipe base short limbate to merely circumscissile; spores weakly amyloid.

- 4. Pileus pale citrin to cream with disc olive to gray; spores $6.7 - 9.1 (-9.5) \times 6.2 - 8.8 \mu\text{m}$, with $Q = 1.06 - 1.09$.
Amanita sp. CR7.
- 4. Pileus red-brown; spores ??, with $Q = \underline{??}$
Amanita sp. CR15.
- 4. Pileus pale gray; spores ??, with $Q = \underline{??}$
Amanita sp. CR14.