



Photographic Guide to the Bryophytes of Grand Canyon-Parashant National Monument



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Cover Photos

Top: Snap Canyon

Bottom: *Grimmia poecilostoma* Cardot & Sebille (Brinda, 1570)

v1.0 (April, 2011)

Introduction

The primary focus of this project was a baseline assessment of the bryophyte diversity on the Grand Canyon-Parashant National Monument (GCPNM). To this end collecting locations were preselected in order to maximize the potential number of species collected at each site. Additional sites were added to this list in order to cover the monument geographically as well as include as many of the major vegetation types as possible. A total of 47 sites (Fig. 1) were visited and 679 voucher specimens were collected. The species that have been identified from these collections are photographically documented in this report. All photos presented here are of plants collected on the GCPNM.

While the monument mostly lacks the wet and humid environments usually associated with bryophytes, it offers a diverse array of geological substrates set in a varied topography. These habitats promote a high diversity of xeric-adapted species especially in the Pottiaceae and Grimmiaceae families (Fig. 2). The monument's location also allows a mixing of the Mojave Desert and Rocky Mountain floras, enhancing its diversity. The new information provided by these collections shows that the bryophyte diversity on the GCPNM has been seriously underestimated in the past. The resulting checklist of 110 species represents a dramatic increase from the most recent survey of the monument (Newberry & Stark 2004) as well as that previously reported for all of Mohave County (Haring 1961). In addition, 23 taxa were apparently newly reported for the State of Arizona and our investigations yielded three taxa that are still undescribed or new to science.

Careful taxonomic work in this region will continue to yield range extensions for well-known species and probably also species new to science.

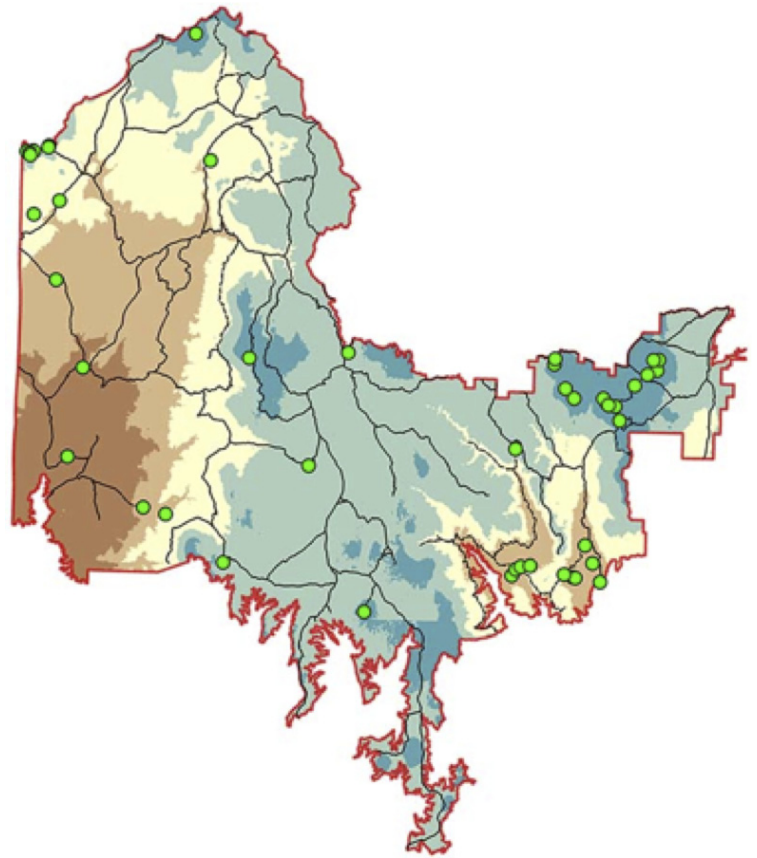


Figure 1. Map of bryophyte collecting sites on the Grand Canyon-Parashant National Monument.

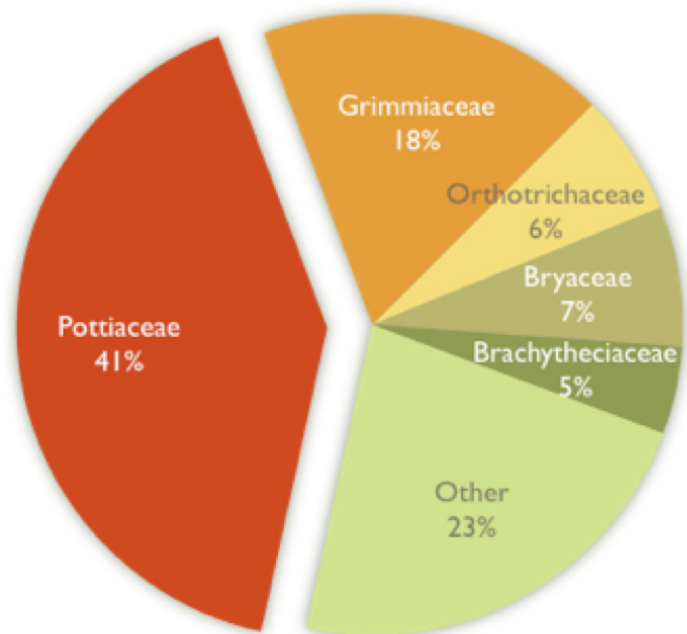


Figure 2. Distribution of the monument's bryophyte diversity among taxonomic families.

Liverworts

Asterella californica (Hampe) Underw.

Distribution: Arizona, California, Mexico, Nevada and Oregon

Habitat: chaparral, oak woodlands and desert canyons

Distinctive Characters: thalloid growth form, elevated carpocephala with large longitudinally slit pseudoperianth

Similar Species: The only other thalloid liverwort found on the monument was *Targionia* which is easily separated by the large 2-valved apical involucre that are usually present. Other similar species in the genera *Mannia* and *Reboulia* are usually separated by the appendages of the ventral scales.

Illustrations: figures 3-5, Howe (1899)



Figure 3. Habit, dry (Brinda, 1677)



AYTONIACEAE

Figure 4. Habit, wet (Brinda, 1677)



Figure 5. Old carpocephala, showing pseudoperianth (Brinda, 1677)

Targionia sp. nov. A.T. Whittemore ined.

Distribution: Mojave Desert

Habitat: chaparral, oak woodlands and desert canyons

Distinctive Characters: thalloid growth form, large 2-valved apical involucre

Similar Species: The distinctive involucre is only found in species of *Targionia*. Although usually included in the widespread species *T. hypophylla*, Mojave Desert populations actually represent an undescribed species.

Illustrations: figures 6-7, Schuster (1992b)

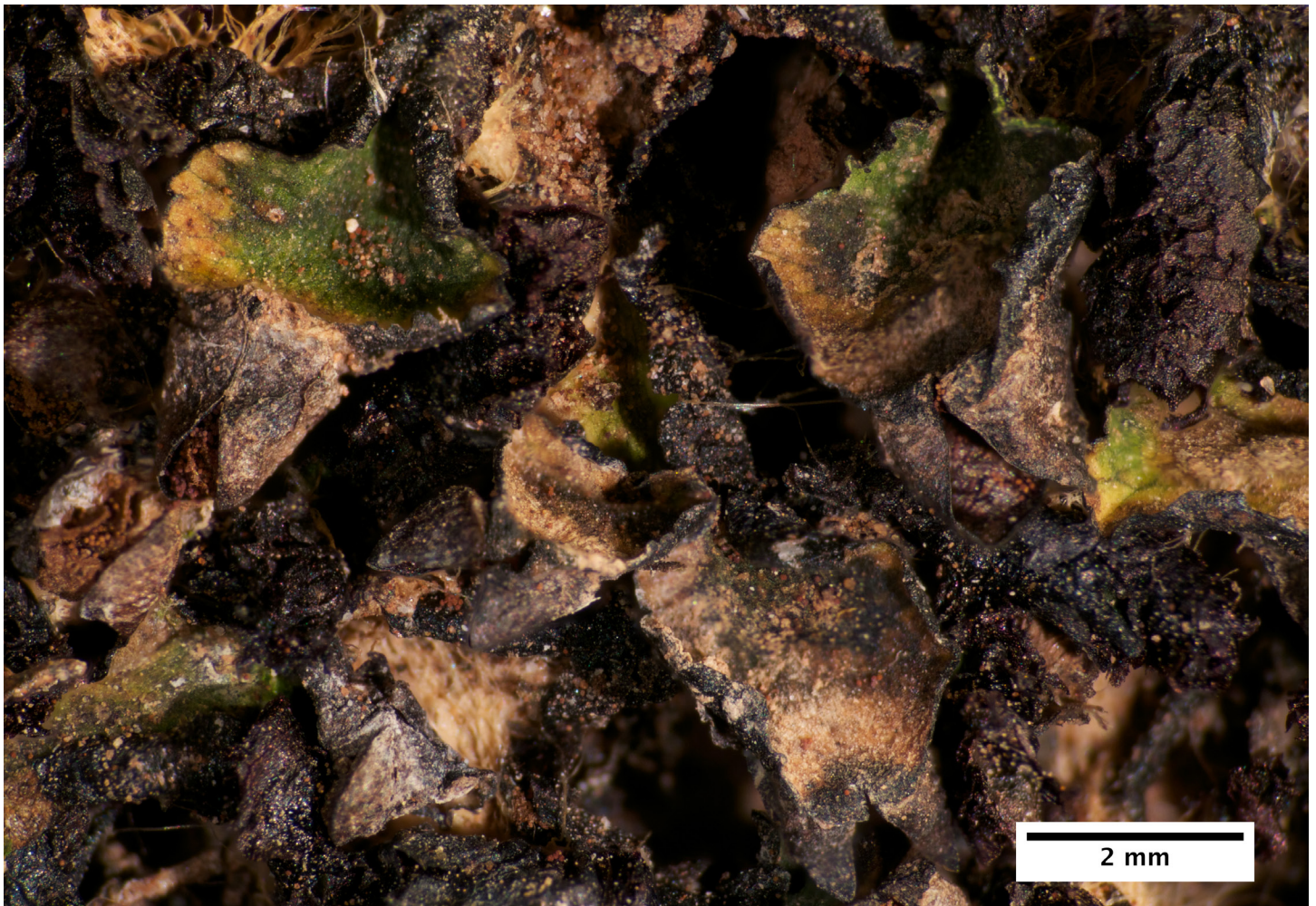


Figure 6. Dry habit, showing involucre (Brinda, 1679)



Figure 7. Habit, wet (Brinda, 1679)

Radula complanata (L.) Dumort.

Distribution: widespread throughout the northern hemisphere

Habitat: epiphytic or saxicolous (found here on shaded rock)

Distinctive Characters: single large oil body per cell, marginal gemmae, underleaves lacking

Similar Species: *Frullania* is similar but has underleaves.

Illustrations: figures 8-9, Damsholt (2002)

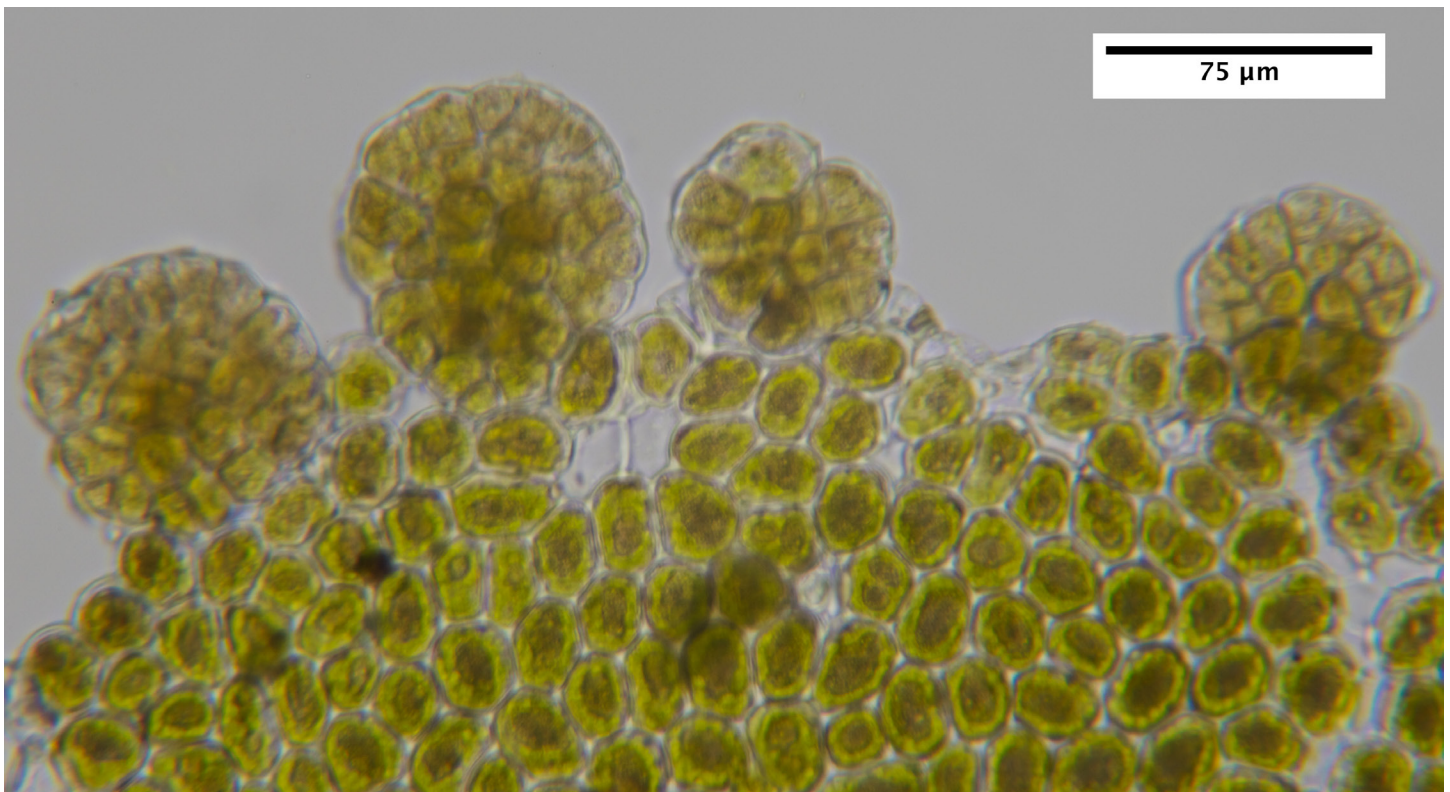


Figure 8. Leaf margin, showing gemmae and large oil bodies (Brinda, 1802)



Figure 9. Habit, dry (Brinda, 1802)

Frullania inflata Gottsche

Distribution: temperate and subtropical northern hemisphere

Habitat: epiphytic or saxicolous (found here on shaded rock)

Distinctive Characters: complicate-bilobed leaves with bilobed underleaves

Similar Species: *Radula* is similar but lacks underleaves.

Illustrations: figure 10, Schuster (1992a)

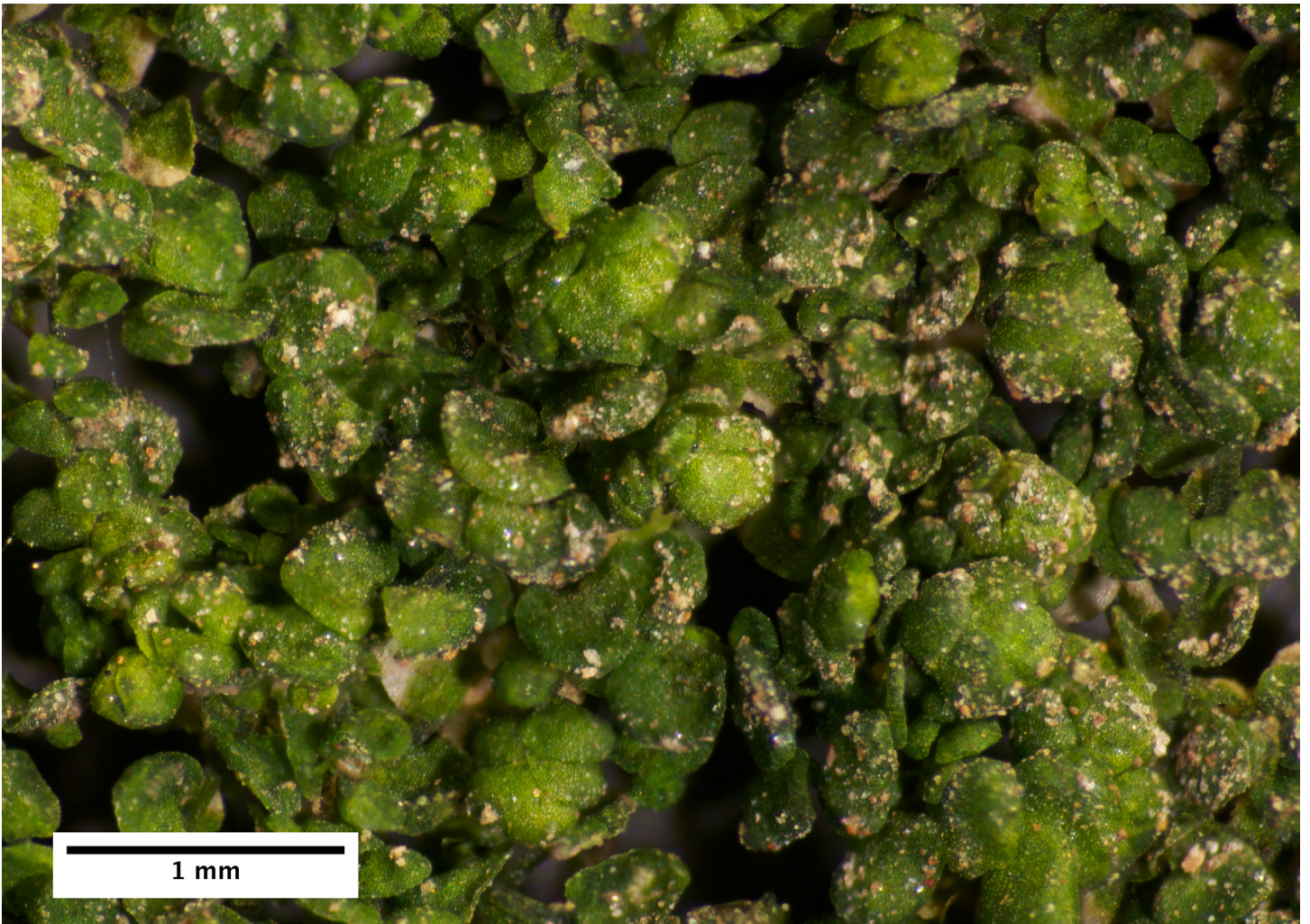


Figure 10. Habit, dry (Brinda, 1763)

Mosses

Timmia bavarica Hessel.

Distribution: temperate northern hemisphere

Habitat: shaded organic soil

Distinctive Characters: large, dark green, crisped leaves; one of the larger mosses on the monument

Similar Species: Reminiscent of Polytrichaceae in the field but lacking leaf lamellae.

Illustrations: figure 11, Flowers (1973)



TIMMIACEAE

Figure 11. Habit, dry (Brinda, 1849)

Encalypta intermedia Jur.

Distribution: western North America and central Asia (true extent unclear due to confusion with other species)

Habitat: montane areas at intermediate elevations; usually in rock crevices

Distinctive Characters: all *Encalypta* have large calyptrae that enclose the capsule when young; leaves never with an elongate hairpoint; very small, quadrate to oblate interior basal cells

Similar Species: *Encalypta vulgaris* has a similar leaf shape but the interior basal cells are more elongate.

Illustrations: figures 12-16, Agnew & Vondráček (1975)



Figure 12. Stems, dry (Brinda, 2133)



Figure 13. Leaf (Brinda, 2133)

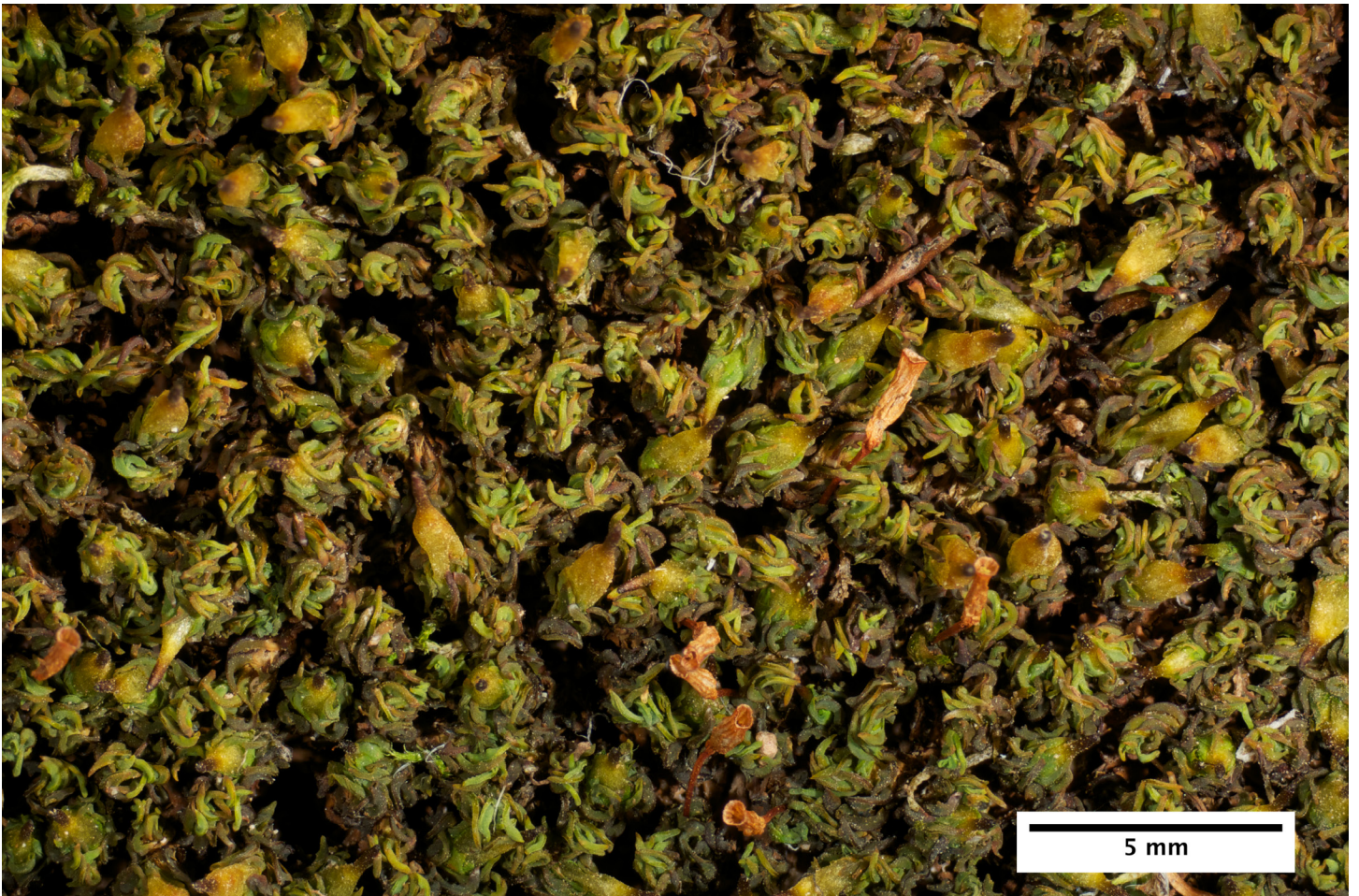


Figure 14. Habit, dry (Brinda, 2133)



Figure 15. Basal cells of leaf (Brinda, 2133)

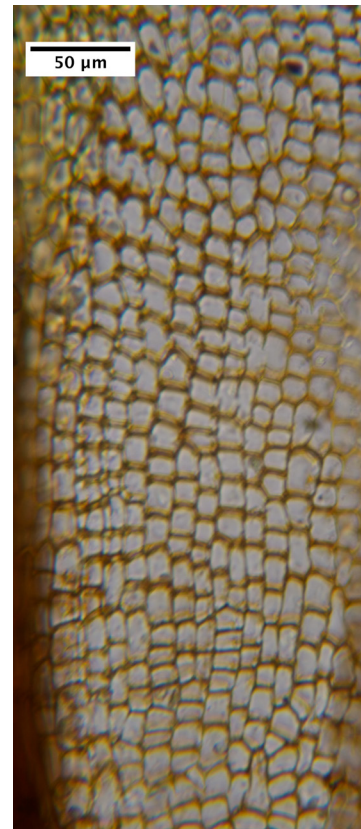


Figure 16. Closer view of basal cells (Brinda, 2133)

Encalypta vulgaris Hedw.

Distribution: widespread in temperate regions

Habitat: montane areas at intermediate elevations; usually on soil

Distinctive Characters: all *Encalypta* have large calyptrae that enclose the capsule when young; leaves never with an elongate hairpoint; rectangular to elongate interior basal cells

Similar Species: *Encalypta intermedia* has a similar leaf shape but the interior basal cells are very small and quadrate to oblate.

Illustrations: figures 17-19, Agnew & Vondráček (1975), Horton (1994)



Figure 17. Habit, dry (Brinda, 2041)



Figure 18. Basal cells of leaf (Brinda, 2041)



Figure 19. Leaf (Brinda, 2041)

Funaria hygrometrica Hedw.

Distribution: truly cosmopolitan (found on all seven continents)

Habitat: in desert areas restricted to wet springs and seeps

Distinctive Characters: long, often twisted setae and sulcate capsules with oblique mouth

Similar Species: *Funaria muhlenbergii* var. *lineata* is much smaller and its capsules are not sulcate.

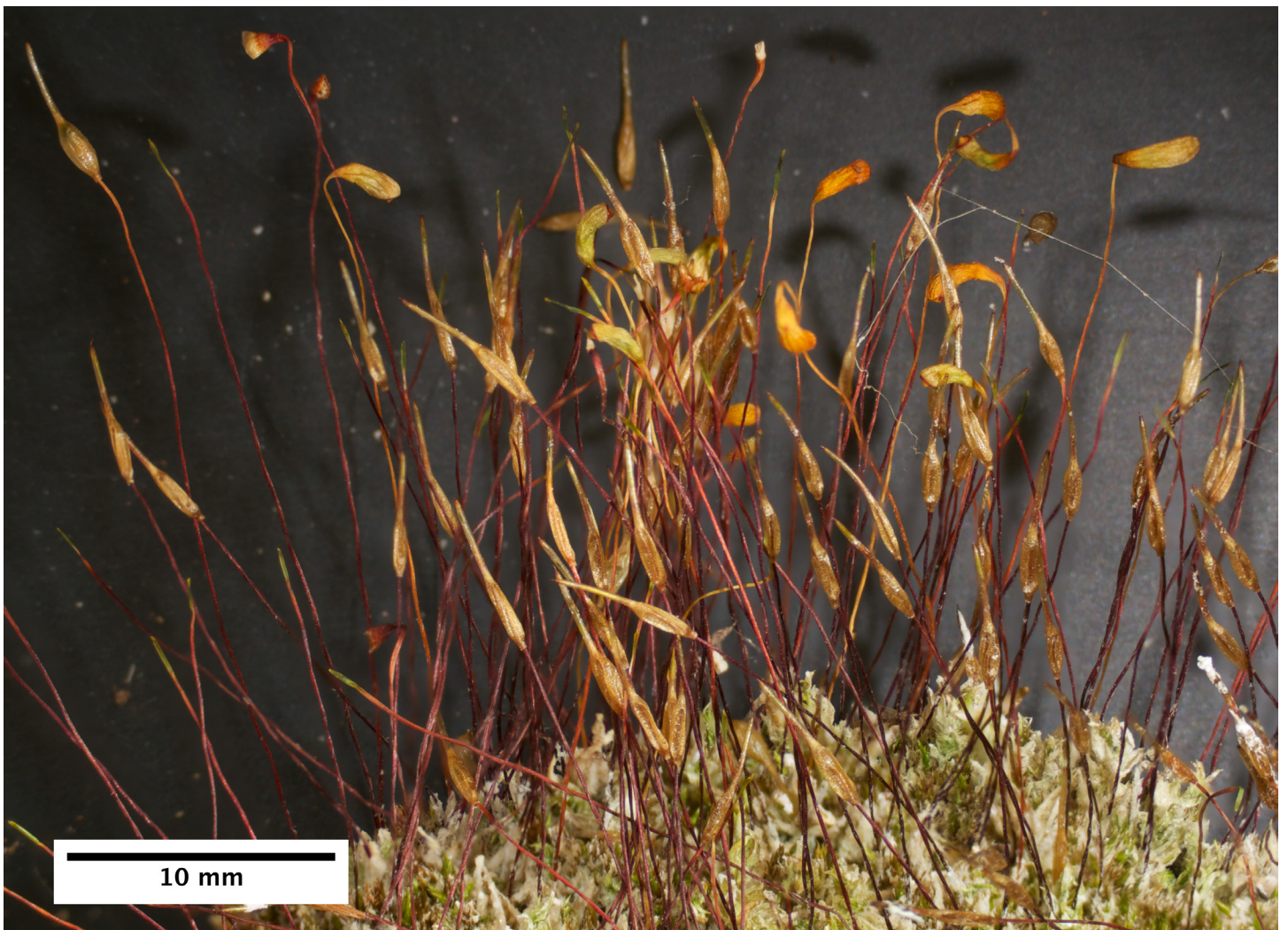
Illustrations: figures 20-23, Flowers (1973)



Figure 20. Capsule, dry (Brinda, 1629)



Figure 21. Leaf (Brinda, 1792)



FUNARIACEAE

Figure 22. Habit, dry (Brinda, 1629)

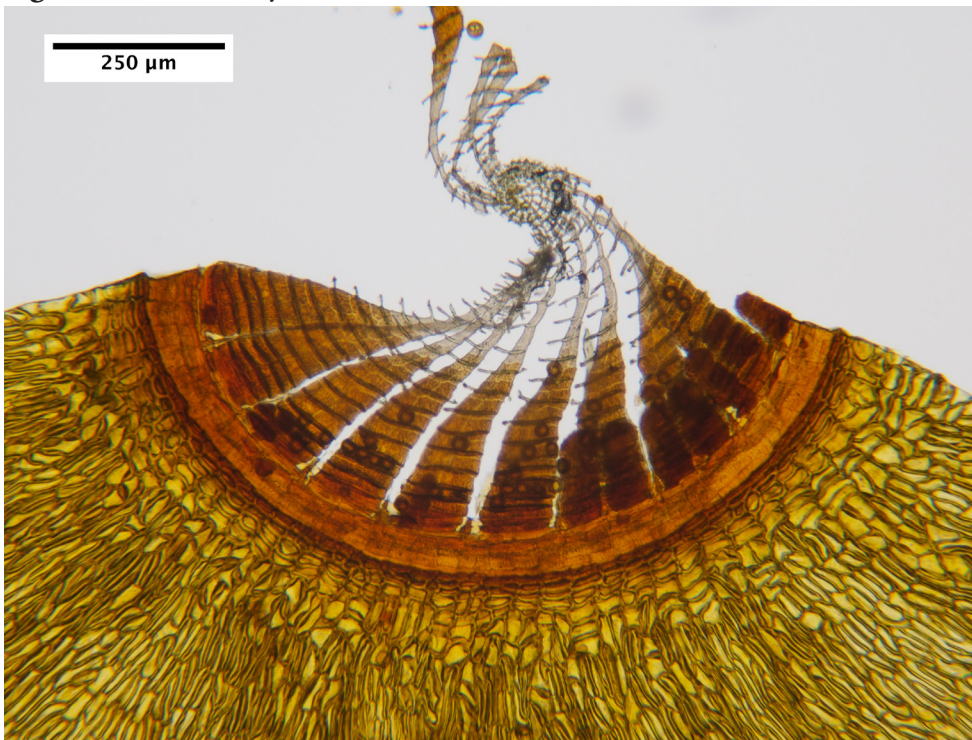


Figure 23. Peristome teeth (Brinda, 1629)

Funaria muhlenbergii var. *lineata* Grout

Distribution: the variety *lineata* may be restricted to the desert southwest

Habitat: seasonally moist soil

Distinctive Characters: small, ephemeral plants with capsules bent at a 90° angle

Similar Species: This plant is related to *Entosthodon pulchellus* but has a less developed peristome.

Illustrations: figures 24-27, Flowers (1973)



Figure 24. Capsule, dry (Brinda, 1629)



Figure 25. Leaf (Brinda, 1792)



Figure 26. Habit, dry (Brinda, 1629)

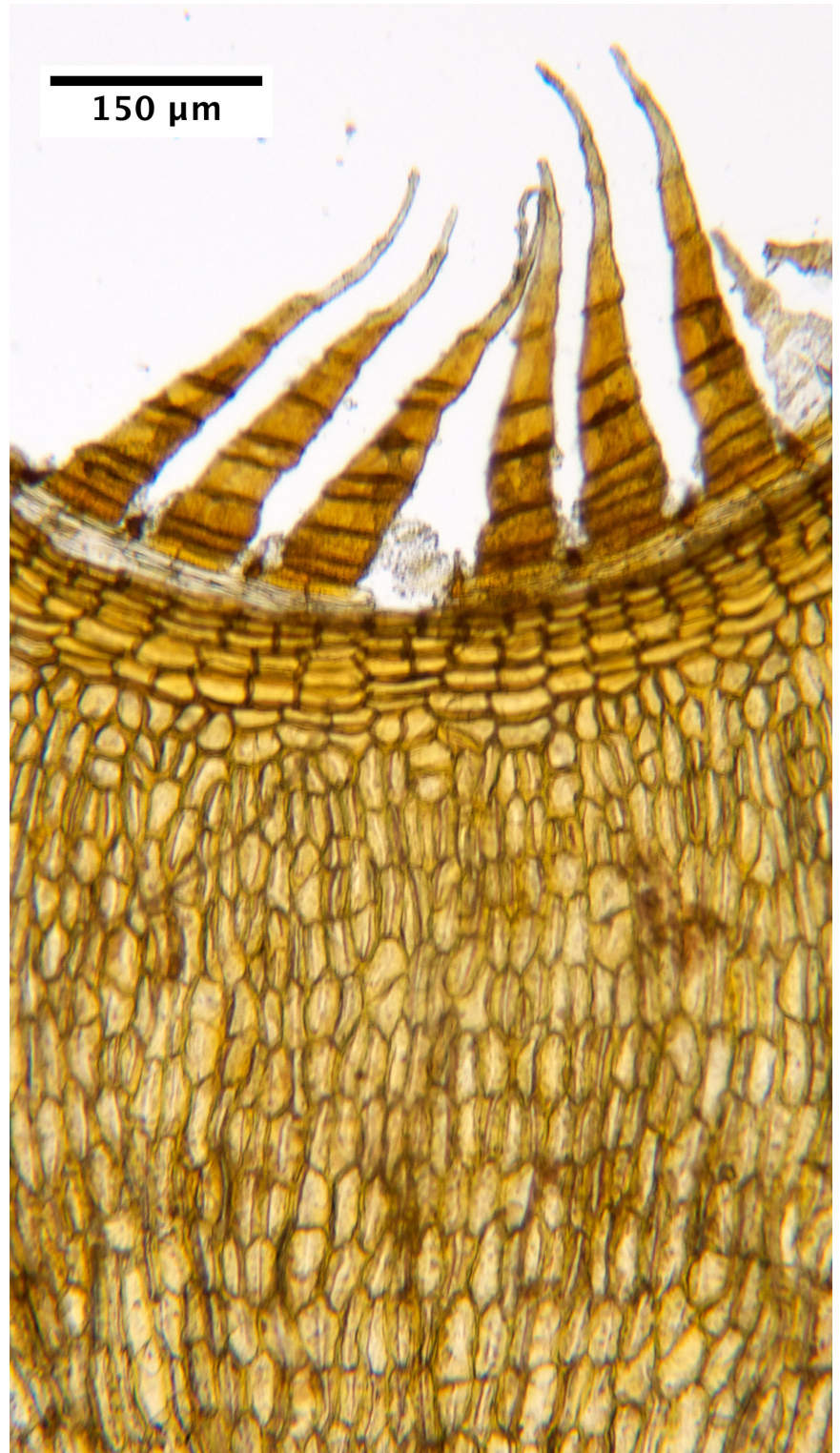


Figure 27. Peristome teeth (Brinda, 1629)

Hymenoloma mulabacenii (Höhn.) Ochyra

Distribution: western North America, Europe, and central Asia

Habitat: on rock and wood in montane forests

Distinctive Characters: longitudinal striae on leaf lamina (reliably present but sometimes faint); bistratose lamina

Similar Species: *Dicranoweisia cirrata* lacks striae while *Hymenoloma crispulum* has a unistratose lamina.

Illustrations: figures 28-29, Abramova & Abramova (1972, as *Dicranoweisia intermedia*)

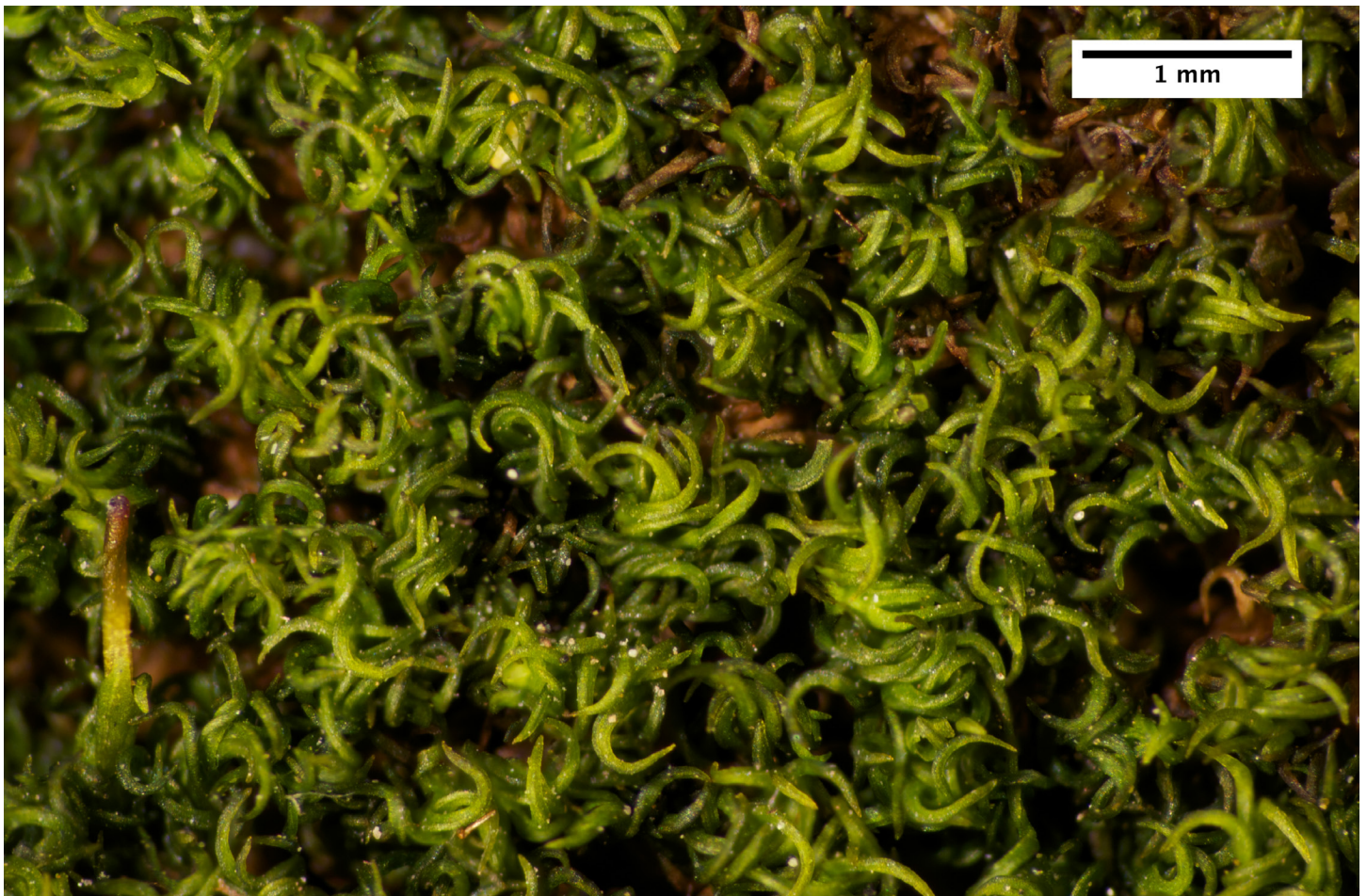


Figure 28. Habit, dry (Brinda, 1906)



Figure 29. Capsule, dry (Brinda, 1776)

Jaffuelobryum raii (Austin) Thér.

Distribution: western North America

Habitat: dry rock (found here on sandstone)

Distinctive Characters: immersed capsules with large calyptrae; bright green, ovate leaves

Similar Species: The leaves of *J. wrightii* are more abruptly rounded to a longer hairpoint.

Illustrations: figure 30, Spence (2007)

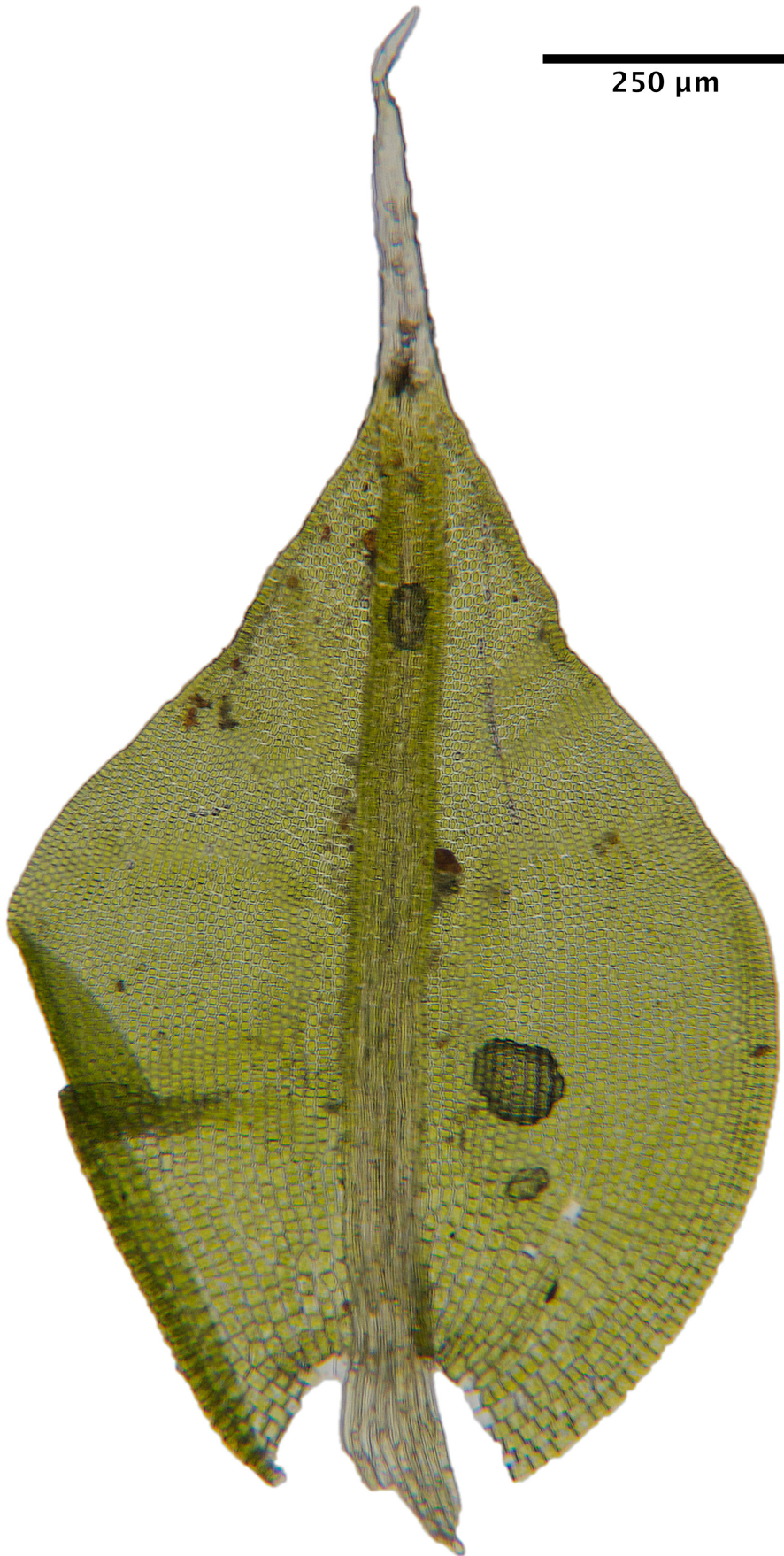


Figure 30. Leaf (Brinda, 1569)

Jaffueliobryum wrightii (Sull.) Thér.

Distribution: North and South America, Asia

Habitat: dry rock (here preferring volcanic substrates)

Distinctive Characters: immersed capsules with large calyptrae; bright green, ovate leaves

Similar Species: The leaves of *J. rauyi* are more gradually tapered to a shorter hairpoint.

Illustrations: figures 31-32, Spence (2007)



Figure 31. Habit, dry (Brinda, 1725)



Figure 32. Leaf (Brinda, 1725)

Dryptodon meridionalis (Müll. Hal.) Ochyra & Żarnowiec

Distribution: mediterranean Europe (not usually separated from *D. trichophyllus* in North America)

Habitat: dry rock (found here on sandstone)

Distinctive Characters: dioicous sexuality, strongly sinuose laminal cells, and keeled leaves

Similar Species: This species is segregated from *D. trichophyllus* on the basis of costal anatomy (refer to Maier 2002).

Illustrations: figure 33, Maier (2002)

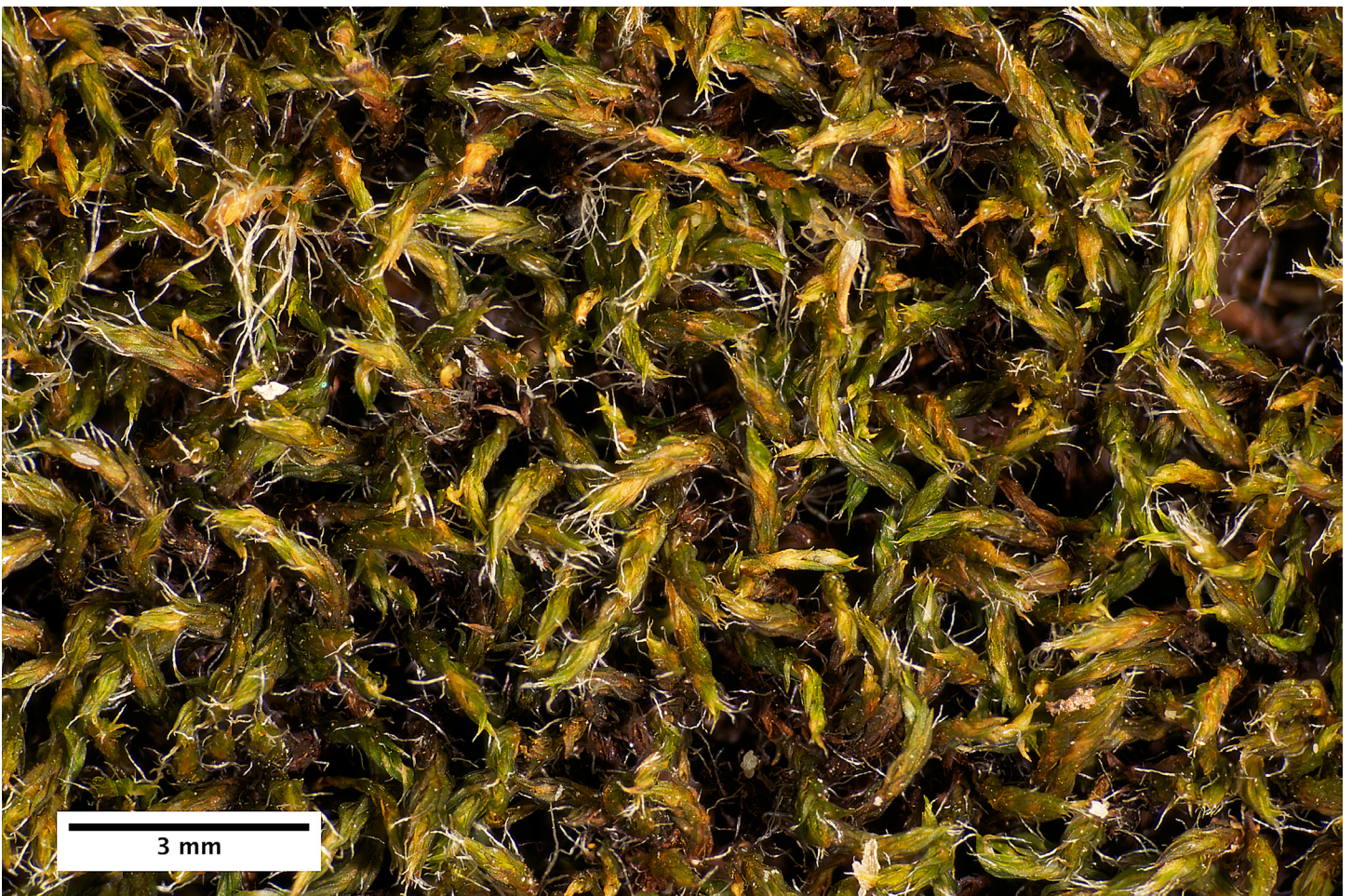


Figure 33. Habit, dry (Brinda, 2213)

Dryptodon torquatus (Drumm.) Brid.

Distribution: widespread in the Northern Hemisphere (but nowhere abundant)

Habitat: shaded rock (here found on basalt)

Distinctive Characters: yellow-green contorted leaves and brown gemmae

Similar Species: *Grimmia incurva* also has contorted leaves but it lacks gemmae.

Illustrations: figure 34, Ignatova & Muñoz (2004, as *Grimmia torquata*)



Figure 34. Habit, dry (Brinda, 1770)

Grimmia anodon Bruch & Schimp.

Distribution: sub-cosmopolitan (mostly northern hemisphere)

Habitat: dry calcareous rock

Distinctive Characters: immersed capsules, lacking peristome and with setae attached off-center; lamina with bistratose patches or striae

Similar Species: *Grimmia plagiopodia* has a well-developed peristome and mostly unistratose lamina.

Illustrations: figure 35, Ignatova & Muñoz (2004)



Figure 35. Habit, dry (Brinda, 2124)

Grimmia plagiopodia Hedw.

Distribution: sub-cosmopolitan (widespread but scattered)

Habitat: dry calcareous rock (preferring sandstone)

Distinctive Characters: immersed capsules, with peristome and setae attached off-center; lamina unistratose or bistratose on margins only

Similar Species: *Grimmia americana* also has a well-developed peristome but the leaf lamina is entirely bistratose.

Illustrations: figure 36, Ignatova & Muñoz (2004)



Figure 36. Habit, dry (Brinda, 2184)

Grimmia poecilostoma Cardot & Sebillé

Distribution: widespread but scattered in the northern hemisphere

Habitat: neutral to acidic rock (here found on sandstone)

Distinctive Characters: wide, flattened, and bright white hairpoints strongly contrasting with thick, blackish-green leaves

Similar Species: Separation from *G. tergestina* is not possible without sporophytes (these were not found on the monument), however *G. tergestina* has yet to be confirmed for North America.

Illustrations: figures 37-38, Ignatova & Muñoz (2004)



Figure 37. Field aspect, dry (Brinda, 1570)

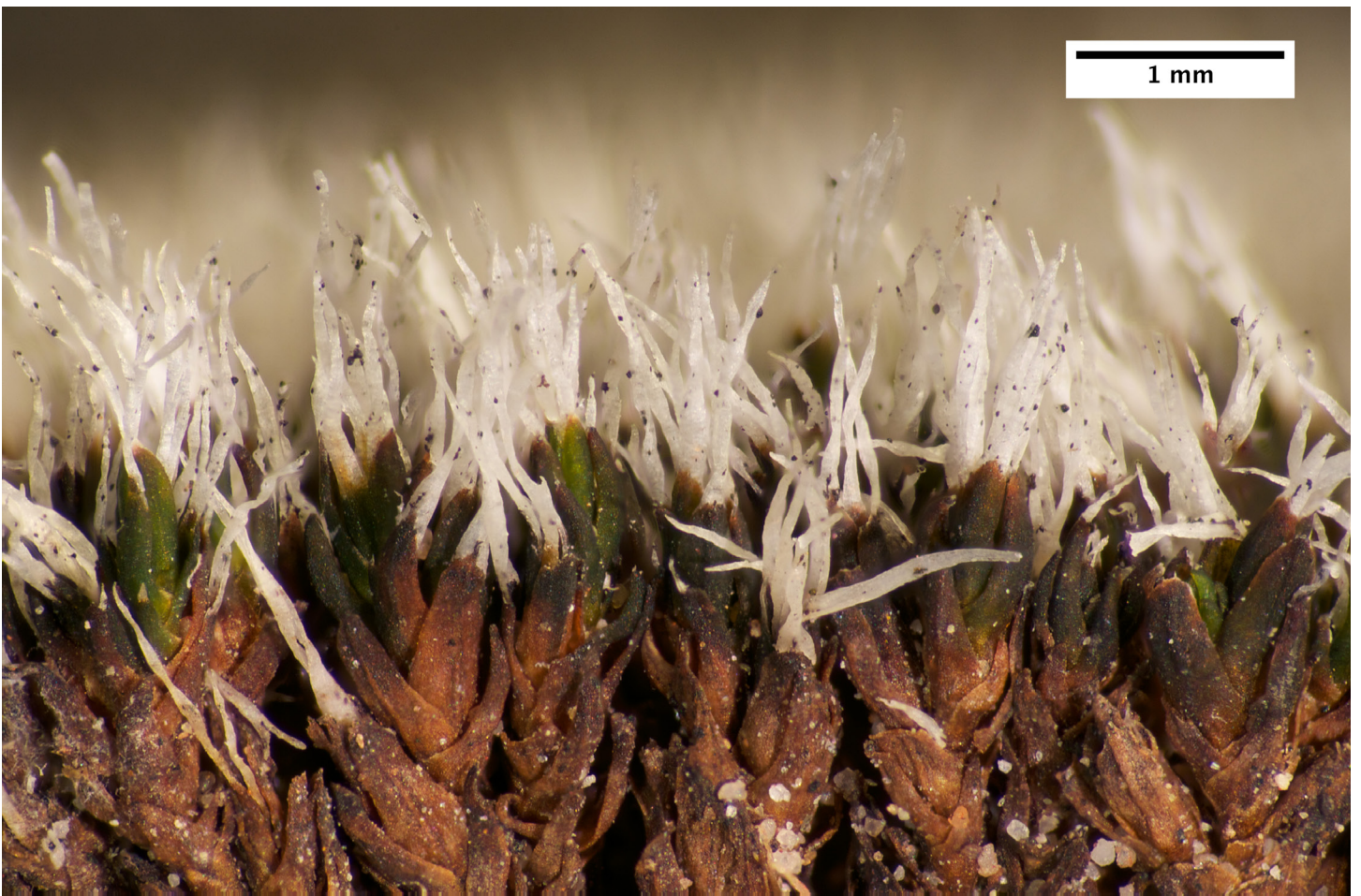


Figure 38. Habit, dry (Brinda, 1570)

Grimmia alpestris (F. Weber & D. Mohr) Schleich.

Distribution: widespread in the northern hemisphere

Habitat: acidic rock

Distinctive Characters: dense cushions of glaucous-green plants; homogeneous, short rectangular basal cells

Similar Species: *Grimmia montana* is darker green and its basal cells are heterogeneous. Plants of *G. montana* also more readily absorb water on rehydration while *G. alpestris* is somewhat hydrophobic.

Illustrations: figures 39-40, Ignatova & Muñoz (2004)



Figure 39. Habit, dry (Brinda, 1780)

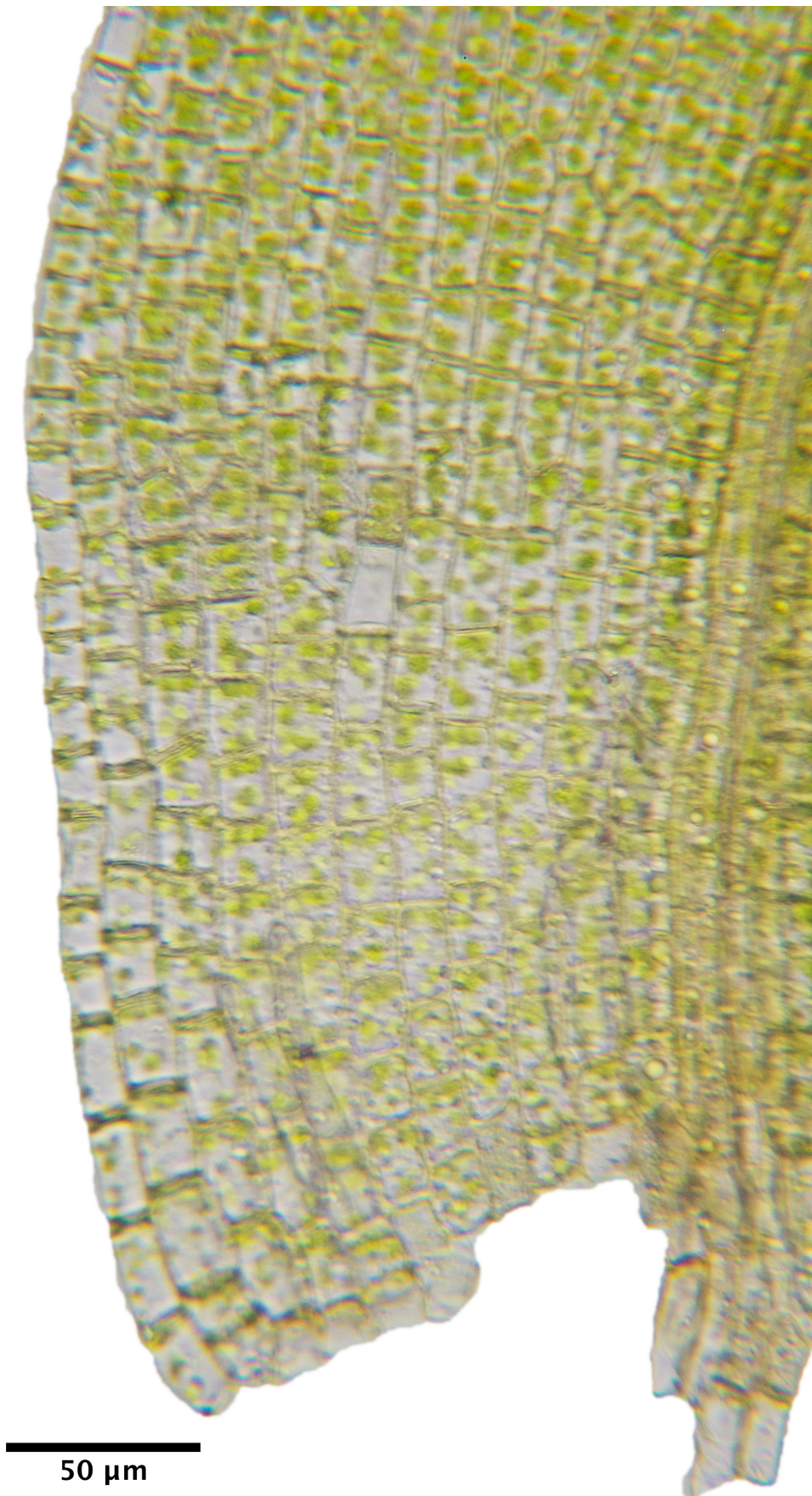


Figure 40. Basal cells of leaf (Brinda, 1780)

Grimmia montana Bruch & Schimp.

Grimmia jamesii Austin

Distribution: widespread in the northern hemisphere

Habitat: dry acidic rock

Distinctive Characters: dense cushions of blackish-green plants; heterogeneous, rectangular basal cells

Similar Species: *Grimmia jamesii* is used here to refer to plants in the *Grimmia montana* complex with basal cells that are more or less uniform, are cladautoicous, have mamillate opercula, and variously reduced peristomes.

Illustrations: figures 41-42 (*G. montana*) figure 43 (*G. jamesii*), Ignatova & Muñoz (2004)

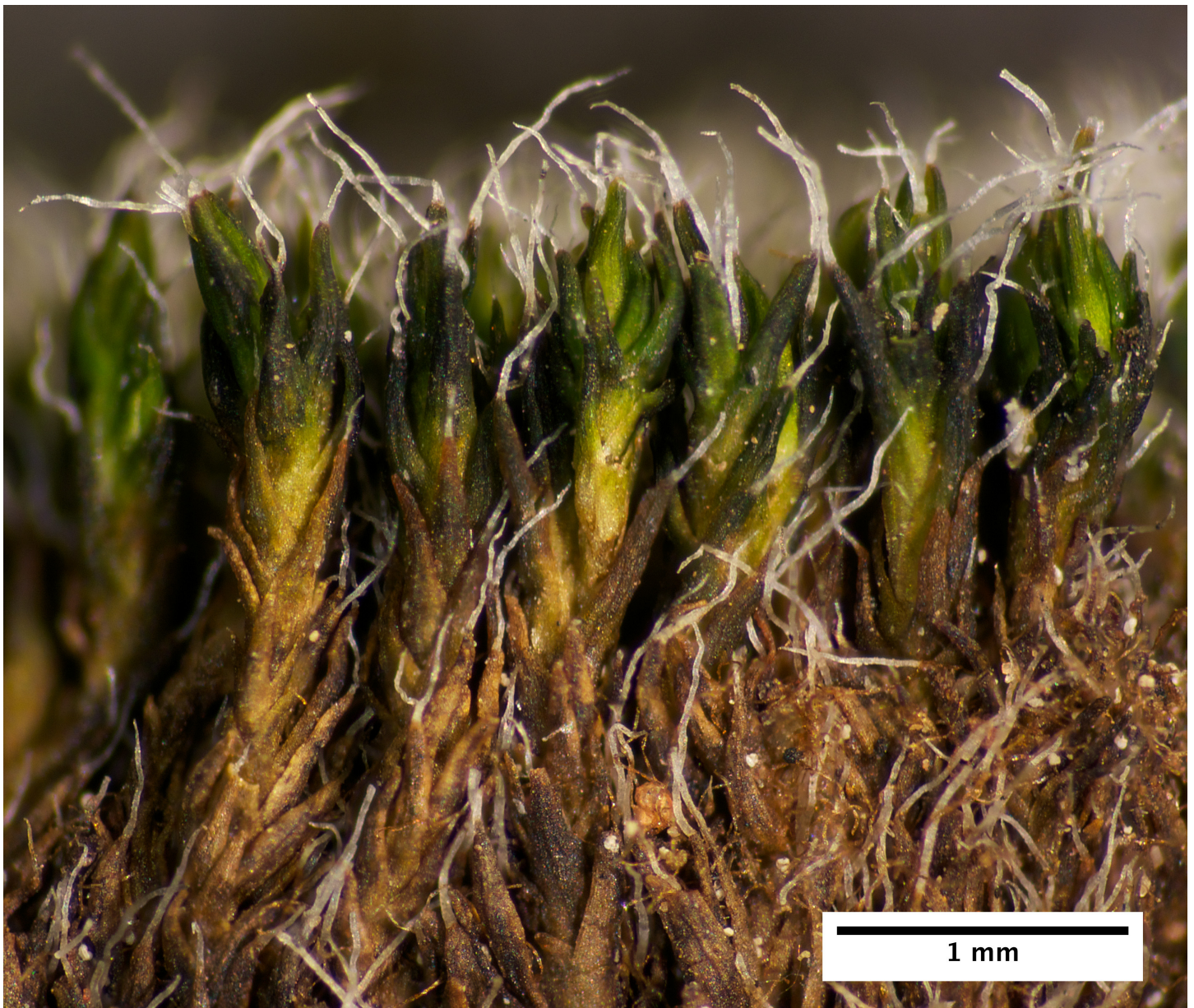


Figure 41. Habit, dry (Brinda, 1760)

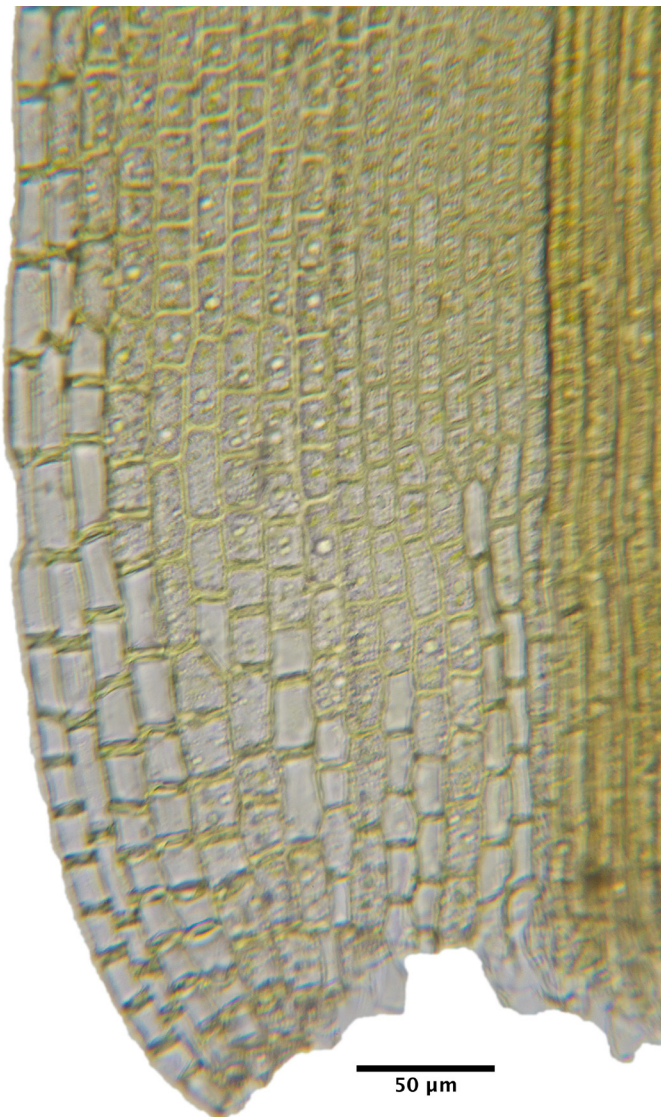


Figure 42. Basal cells of leaf (Brinda, 1760)

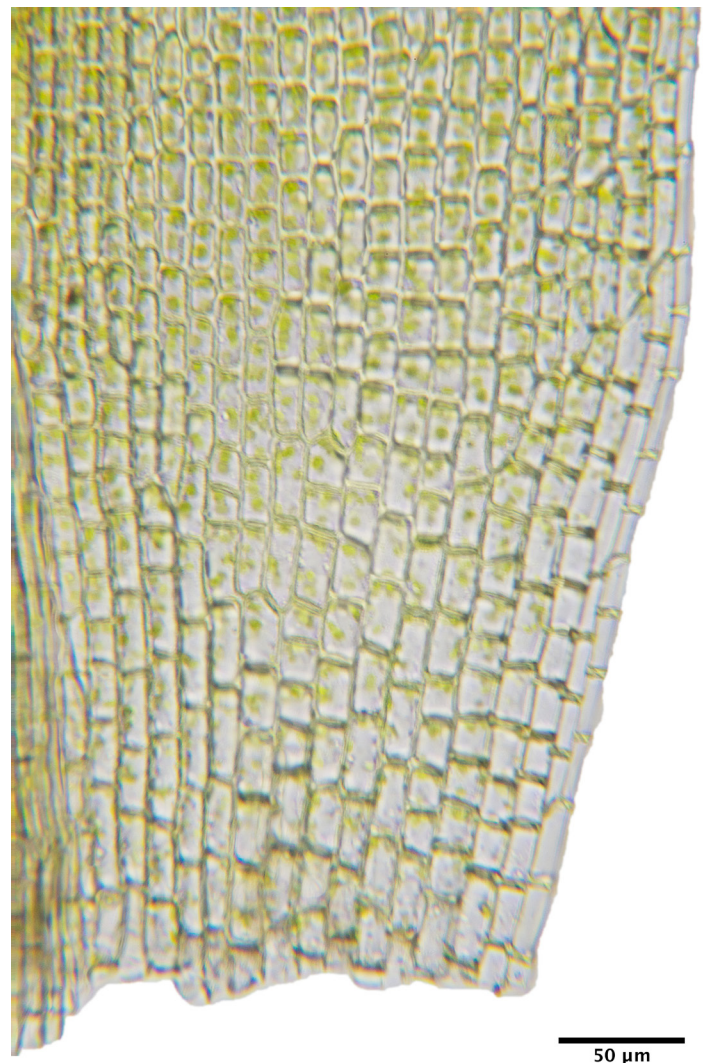


Figure 43. Basal cells of leaf (Brinda, 2228)

Grimmia longirostris Hook.

Distribution: sub-cosmopolitan

Habitat: neutral and acidic rock

Distinctive Characters: autoicous and usually bearing numerous exserted, cylindrical capsules; lamina bistratose

Similar Species: *Grimmia ovalis* is dioicous and its leaves have well-defined shoulders.

Illustrations: figure 44, Ignatova & Muñoz (2004)



Figure 44. Habit, dry (Brinda, 1830)

Grimmia ovalis (Hedw.) Lindb.

Distribution: widespread in the northern hemisphere

Habitat: dry acidic rock

Distinctive Characters: flattened, weakly differentiated costa; leaves ovate-lanceolate

Similar Species: See notes under *G. longirostris* and *G. laevigata*.

Illustrations: figure 45, Ignatova & Muñoz (2004)



Figure 45. Habit, dry (Brinda, 1764)

Grimmia laevigata (Brid.) Brid.

Distribution: sub-cosmopolitan

Habitat: dry acidic rock

Distinctive Characters: flattened, weakly differentiated costa; leaves oblong to ovate with quadrate to transversely elongate basal cells

Similar Species: The leaves of *G. ovalis* have well-defined shoulders and rectangular basal cells.

Illustrations: figure 46, Ignatova & Muñoz (2004)

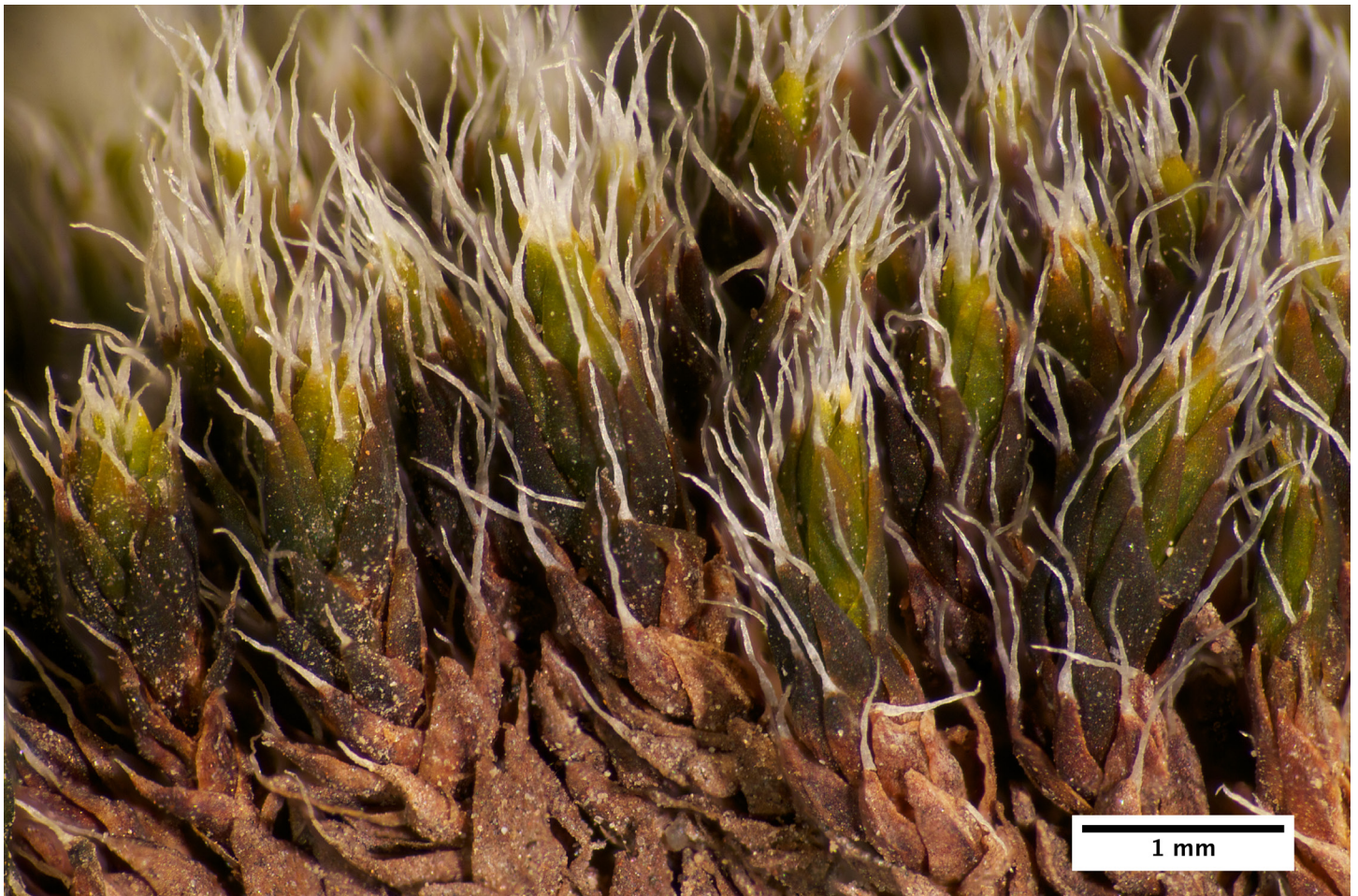


Figure 46. Habit, dry (Brinda, 2058)

Grimmia pulvinata (Hedw.) Sm.

Distribution: sub-cosmopolitan

Habitat: dry rock

Distinctive Characters: elliptic, keeled leaves with long awns; usually bearing numerous arcuate sporophytes

Similar Species: The leaves of *G. orbicularis* are completely unistratose and have more elongate basal cells.

Illustrations: figure 47, Ignatova & Muñoz (2004)



Figure 47. Habit, dry (Brinda, 1868)

Grimmia calyptrata Drumm.

Distribution: western North America

Habitat: dry rock

Distinctive Characters: sporophytes with large calyptra covering over half the capsule; elongate, thin-walled inner basal cells

Similar Species: Sterile plants can be confused with *G. pulvinata* but have elongate, thin-walled inner basal cells.

Illustrations: figures 48-49, Hastings (1999, as *Coscinodon calyptratus*)



Figure 48. Habit, dry (Brinda, 1794)



GRIMMIACEAE

Figure 49. Habit, dry (Brinda, 1794)

Grimmia orbicularis Bruch

Distribution: sub-cosmopolitan

Habitat: usually on dry calcareous rock (here also found on gypsum and highly calcareous soils)

Distinctive Characters: leaf unistratose throughout; usually bearing numerous arcuate sporophytes

Similar Species: *Grimmia moxleyi* has awns only on the perichaetial leaves and its lamina is partly bistratose.

Illustrations: figure 50, Ignatova & Muñoz (2004)

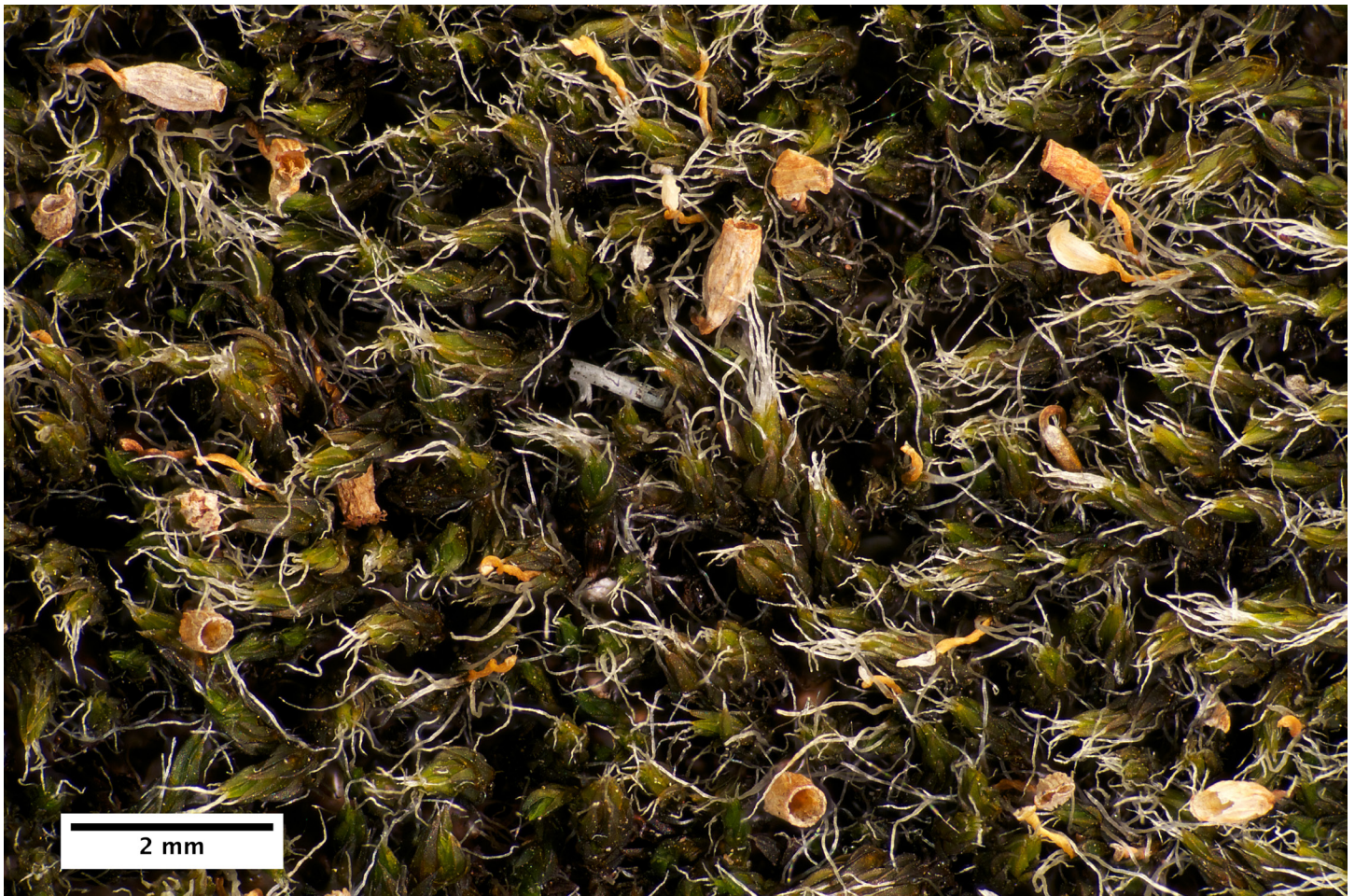


Figure 50. Habit, dry (Brinda, 1685)

Grimmia moxleyi R.S. Williams

Distribution: southwestern United States, Baja California, and northwestern Mexico

Habitat: dry acidic rock

Distinctive Characters: muticous leaves contrasting sharply with the long-awned perichaetial leaves

Similar Species: The lamina of *G. orbicularis* is unistratose throughout and most of its leaves bear long awns.

Illustrations: figure 51, Hastings & Greven (2007)



Figure 51. Habit, dry (Brinda, 1712)

Schistidium cinclidodonteum (Müll. Hal.) B. Bremer

Distribution: western North America and Europe

Habitat: seasonally wet rock

Distinctive Characters: long falcate leaves with thick, fleshy apiculus; lamina bistratose distally with bistratose strips extending to the leaf base along the costa

Similar Species: The lamina of *S. occidentale* is mostly unistratose.

Illustrations: figure 52, Flowers (1973)

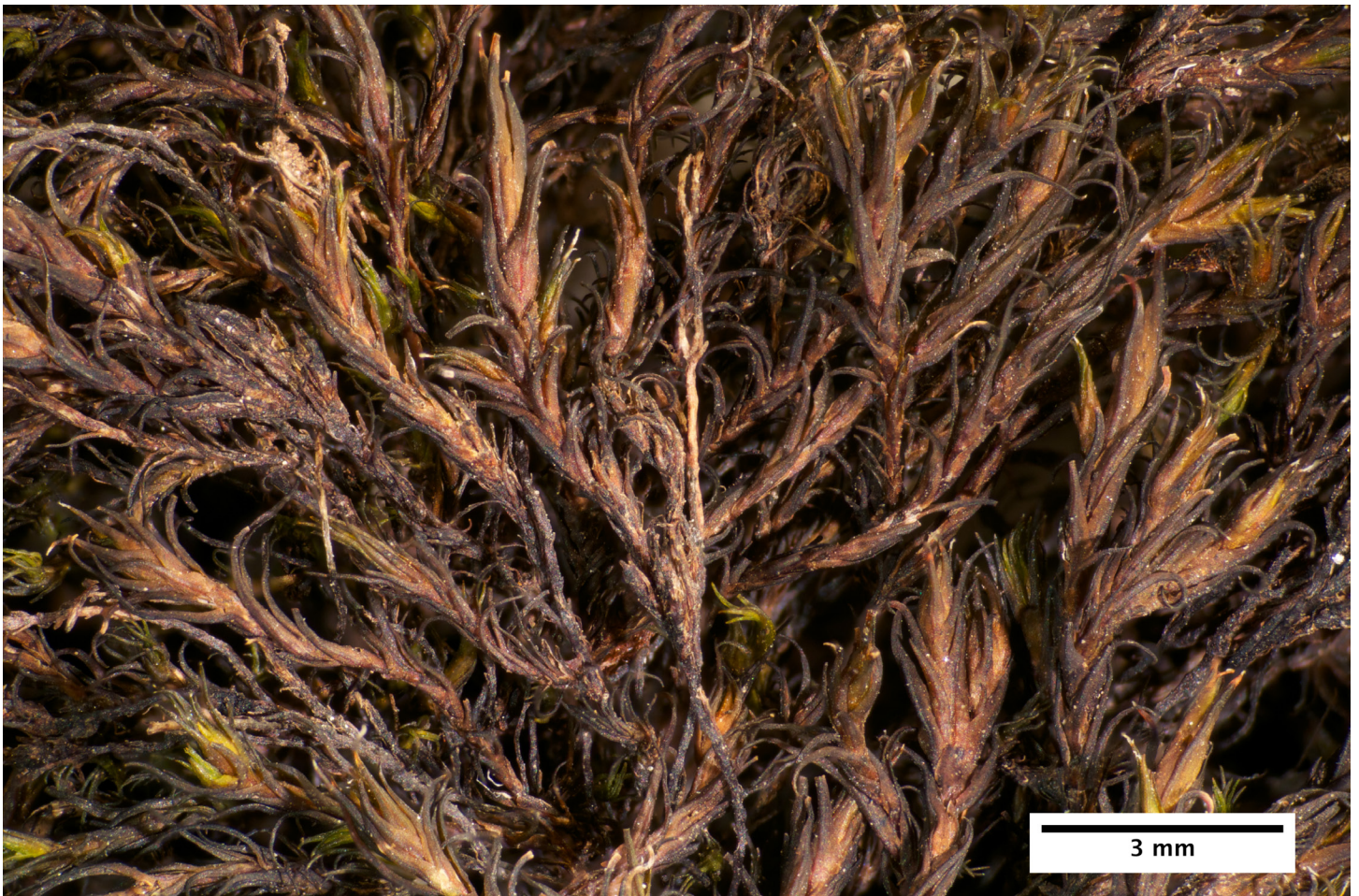


Figure 52. Habit, dry (Brinda, 1761)

Schistidium sp.nov. H.H. Blom ined.

Distribution: unclear but at least in California, Nevada, and Arizona

Habitat: dry rock in desert canyons

Distinctive Characters: blackish-green plants; awns (when present) short, stout and very spinose; leaves with mostly bistratose lamina and somewhat squarrose when wet

Similar Species: According to Hans Blom (personal communication) several species in the southwest mountains await formal description and clarification—until then identification is tentative.

Illustrations: figure 53

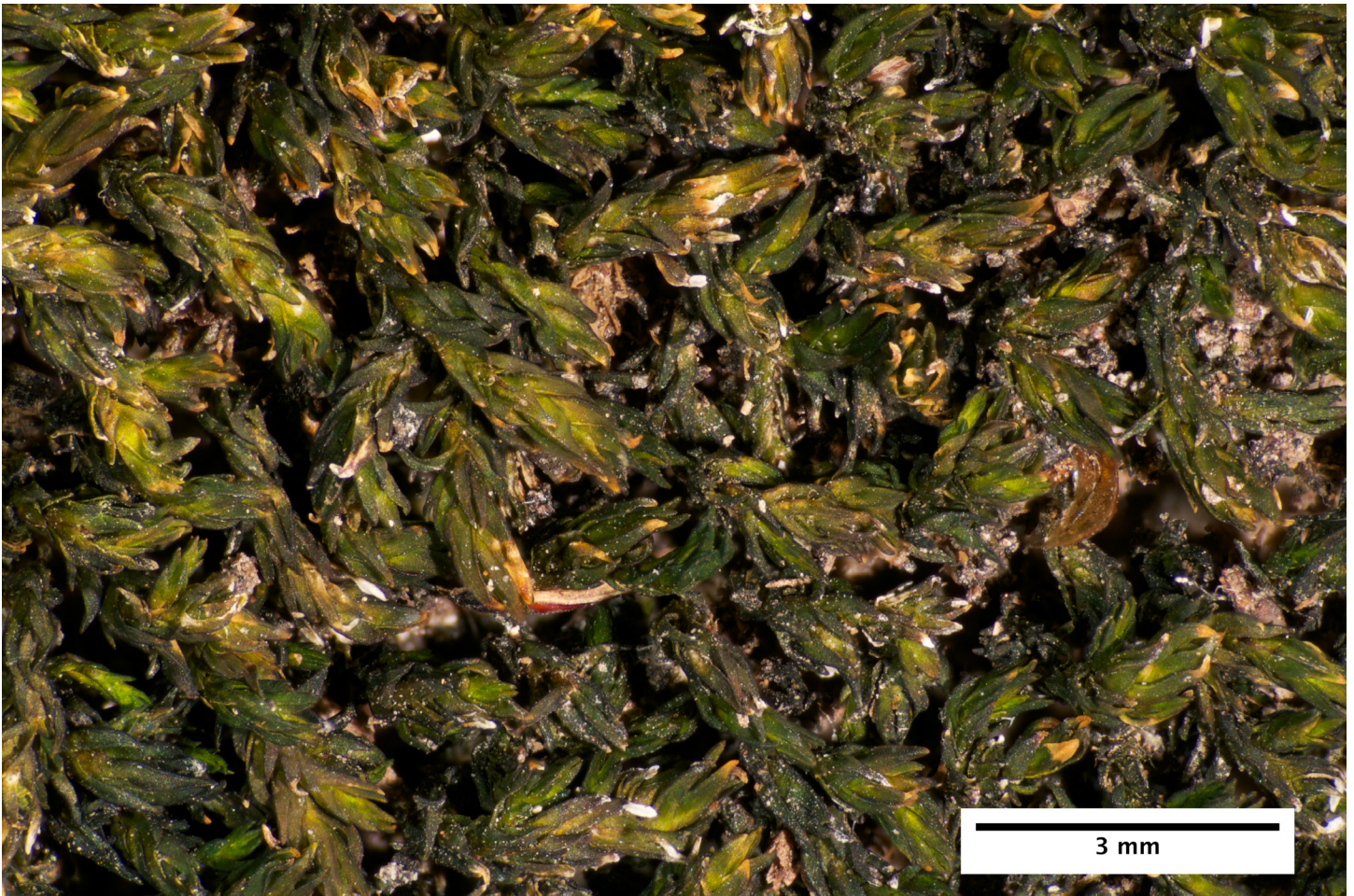


Figure 53. Habit, dry (Brinda, 1728)

Schistidium ambiguum Sull.

Distribution: southwestern US (but true extent not yet well known)

Habitat: dry rock

Distinctive Characters: bright green, waxy-looking plants with stout, terete, whitish awns

Similar Species: Similar to some species in the *S. confertum* group but usually with much more prominent awns.

Illustrations: figure 54, Sullivant (1864)

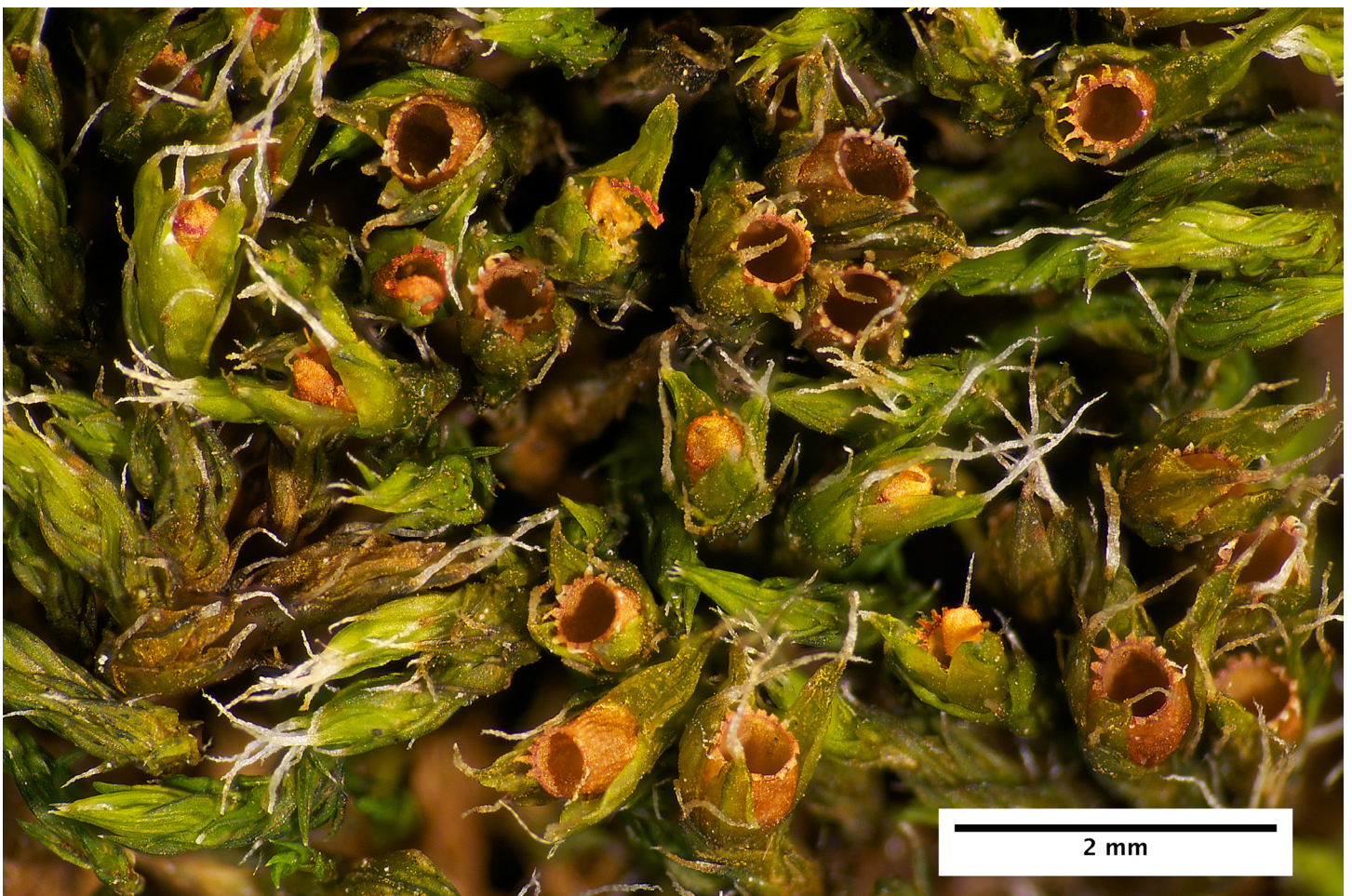


Figure 54. Habit, dry (Brinda, 1929)

Schistidium lancifolium (Kindb.) H.H. Blom

Distribution: widespread in the northern hemisphere

Habitat: dry rock

Distinctive Characters: dull, olive-green plants with awns mostly lacking or very short

Similar Species: Related to *S. apocarpum* but with shorter peristome teeth.

Illustrations: figure 55, Blom (1996)

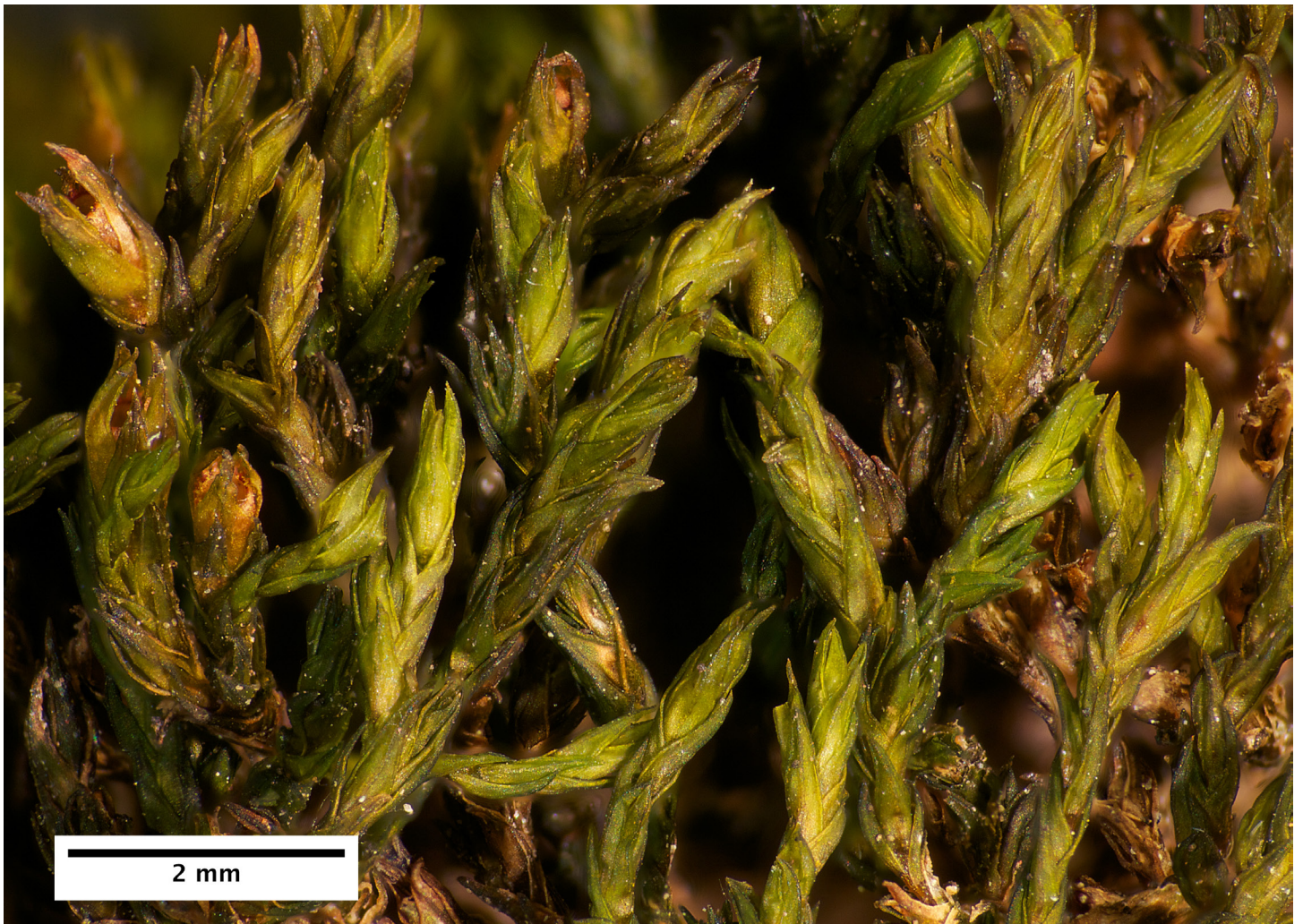


Figure 55. Habit, dry (Brinda, 1781)

Fissidens bryoides var. *pusillus* (Wilson) Pursell

Fissidens exiguus Sull.

Distribution: widespread in the northern hemisphere

Habitat: moist soil and seasonally wet rock

Distinctive Characters: complanate leaves and vaginant lamina; clear, non-bulging laminal cells

Similar Species: *Fissidens exiguus* is smaller than *F. bryoides* and striking in its complete lack of a marginal border.

Illustrations: figures 56-57 (*F. bryoides*), figure 58 (*F. exiguus*), Crum & Anderson (1981)

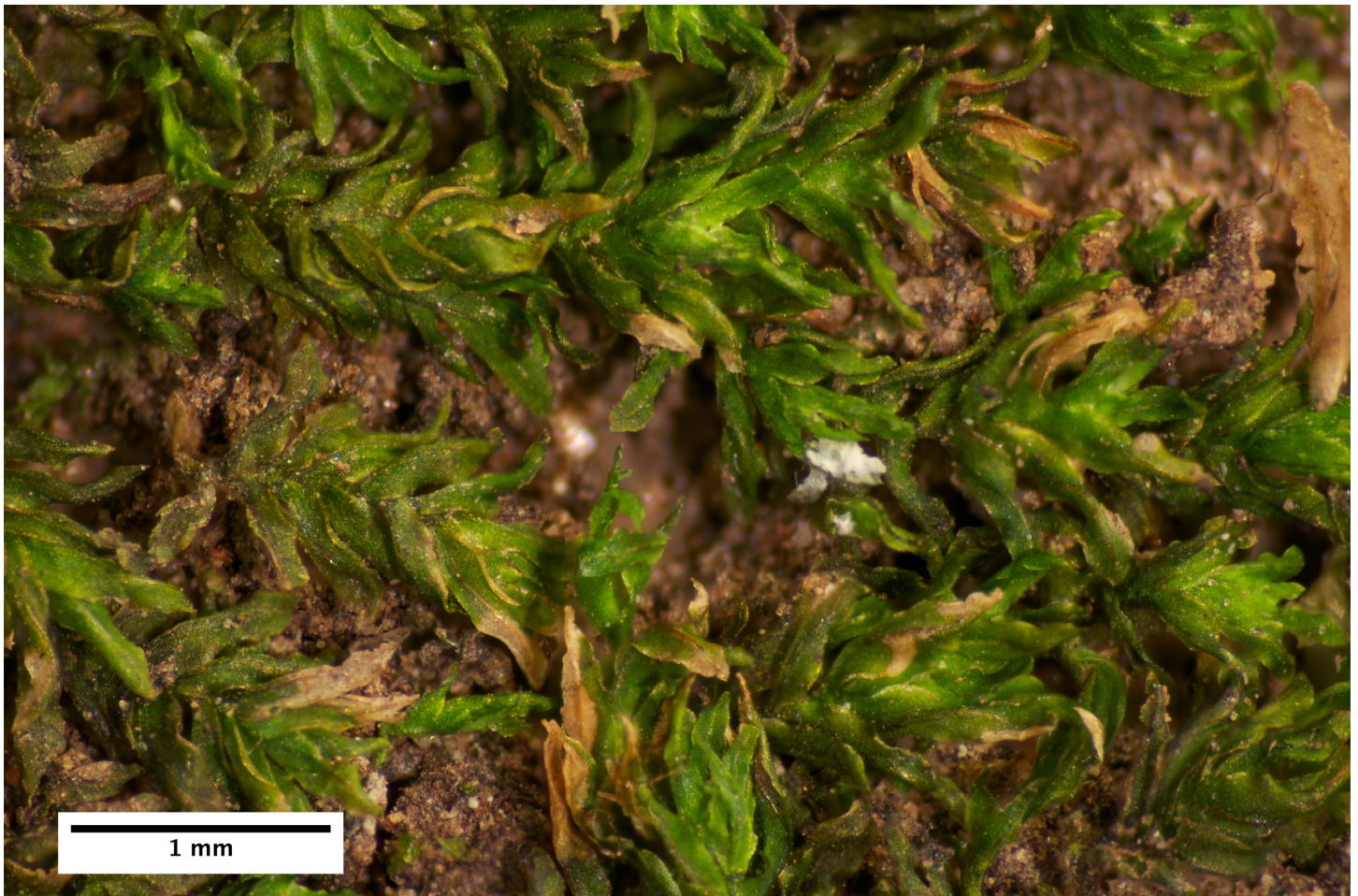


Figure 56. Habit, dry (Brinda, 2241)



Figure 57. Leaf apex of *Fissidens bryoides* (Brinda, 2241)

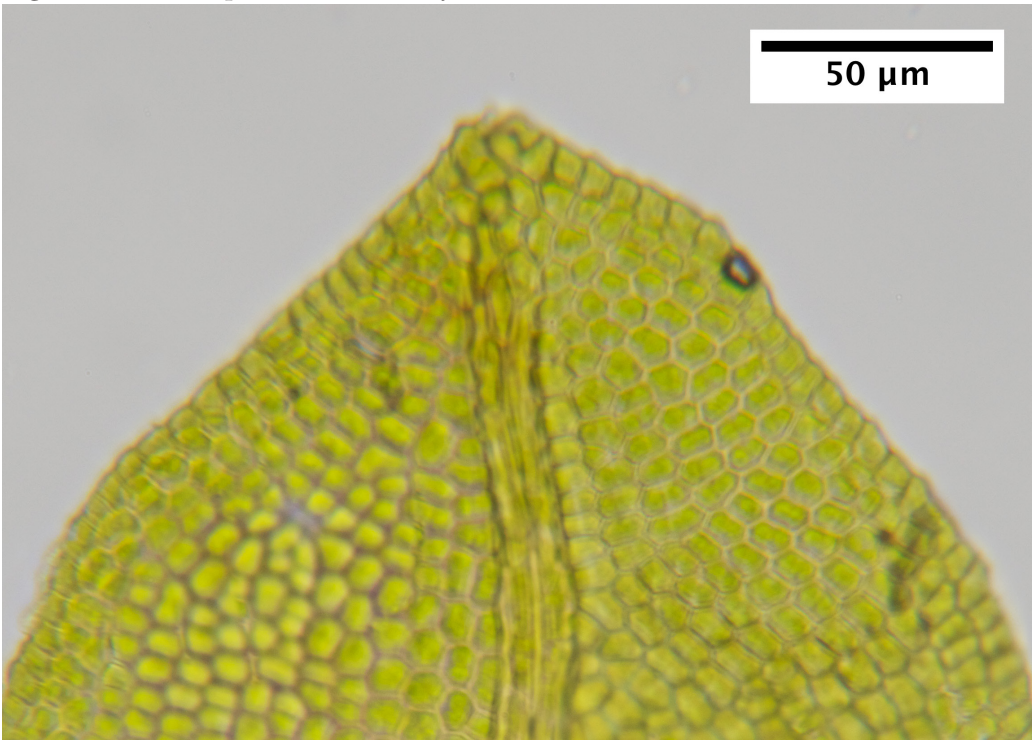


Figure 58. Leaf apex of *Fissidens exiguus* (Brinda, 1678)

Fissidens sublimbatus Grout

Distribution: western North America, South America, and Africa

Habitat: deeply shaded soil and seasonally wet rock

Distinctive Characters: small, bulging laminal cells and often truncate dorsal lamina

Similar Species: *Fissidens crispus* also has bulging cells but is larger and the leaves are crispate when dry.

Illustrations: figures 59-60, Pursell (1994)

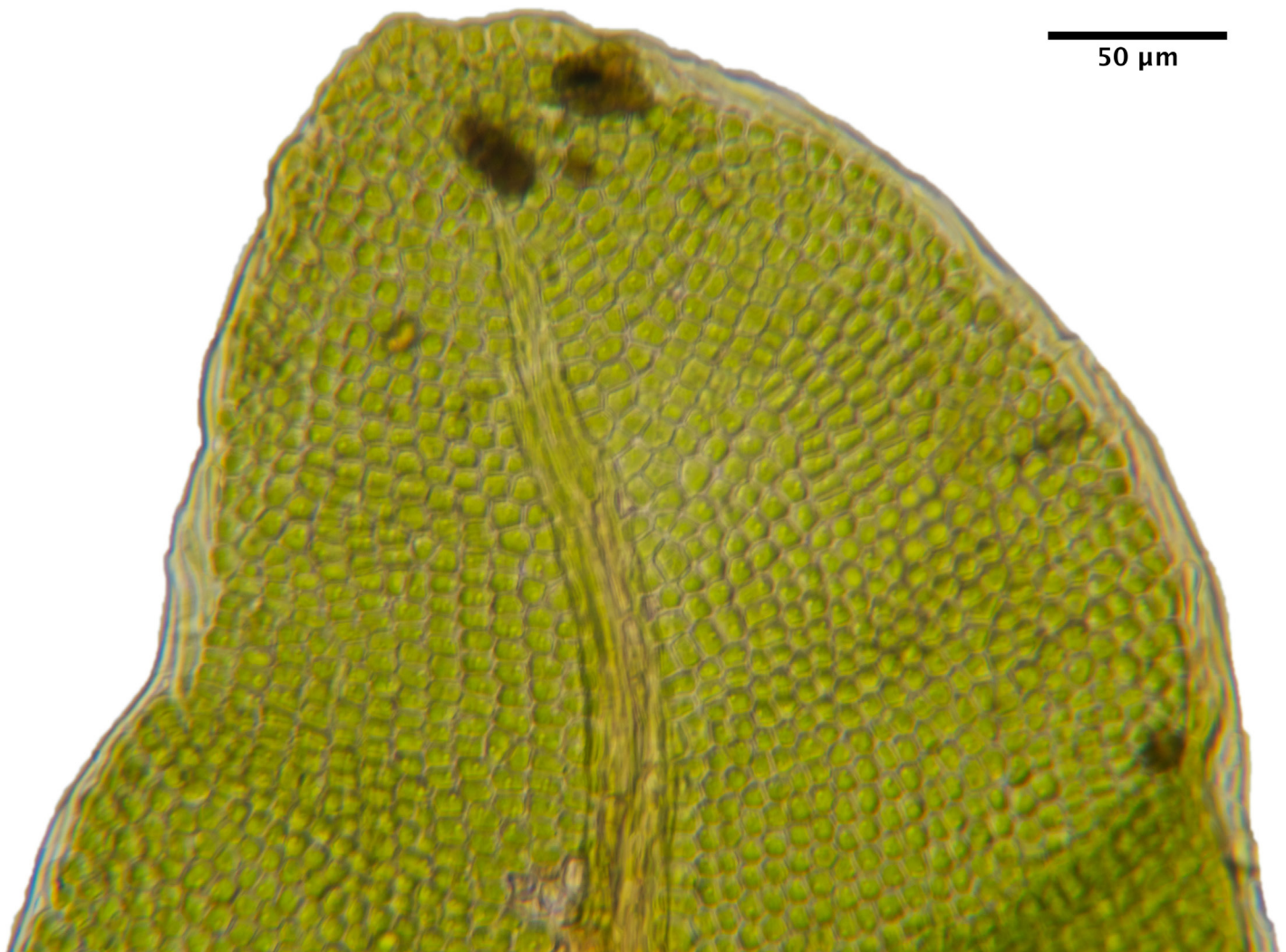


Figure 59. Leaf apex (Brinda, 1637b)



FISSIDENTACEAE

Figure 60. Leaf (Brinda, 1637b)

Ceratodon purpureus (Hedw.) Brid. subsp. *purpureus*

Distribution: widespread in the northern hemisphere

Habitat: weedy species of various substrates but absent from low desert environments

Distinctive Characters: remarkably polymorphic and often fooling experienced bryologists; look for smooth, quadrate to irregularly shaped laminal cells and a slightly serrate margin near the leaf apex

Similar Species: Might be confused with *Didymodon* species but the laminal cells are smooth and the sporophytes distinctive.

Illustrations: figures 61-62, Flowers (1973)



Figure 61. Habit, dry (Brinda, 1863)



Figure 62. Sporophyte (Brinda, 1858)

Anoetangium handelii Schiffner

Distribution: southwestern US, Europe, and Asia

Habitat: rock crevices (usually sandstone)

Distinctive Characters: dense turfs of tiny plants growing in rock crevices

Similar Species: *Gymnostomum* species grow in similar habitats but lack the deep costal groove of this plant.

Illustrations: figures 63-64, Zander & Weber (2005)



Figure 63. Habit, dry (Brinda, 1971)



POTTIACEAE

Figure 64. Leaf (Brinda, 1971)

Gymnostomum aeruginosum Sm.

Gymnostomum calcareum Nees & Hornsch.

Gymnostomum viridulum Brid.

Distribution: sub-cosmopolitan

Habitat: rock crevices, usually where there is seasonal seepage of water

Distinctive Characters: dense turfs of tiny plants growing in rock crevices

Similar Species: Because sporophytes are rare the three species of *Gymnostomum* are separated based of leaf size/shape and the presence/absence of asexual gemmae (refer to Zander et al. 2007).

Illustrations: figures 65-66 (*G. calcareum*), 67 (*G. aeruginosum*), 68 (*G. viridulum*), Zander et al. (2007)

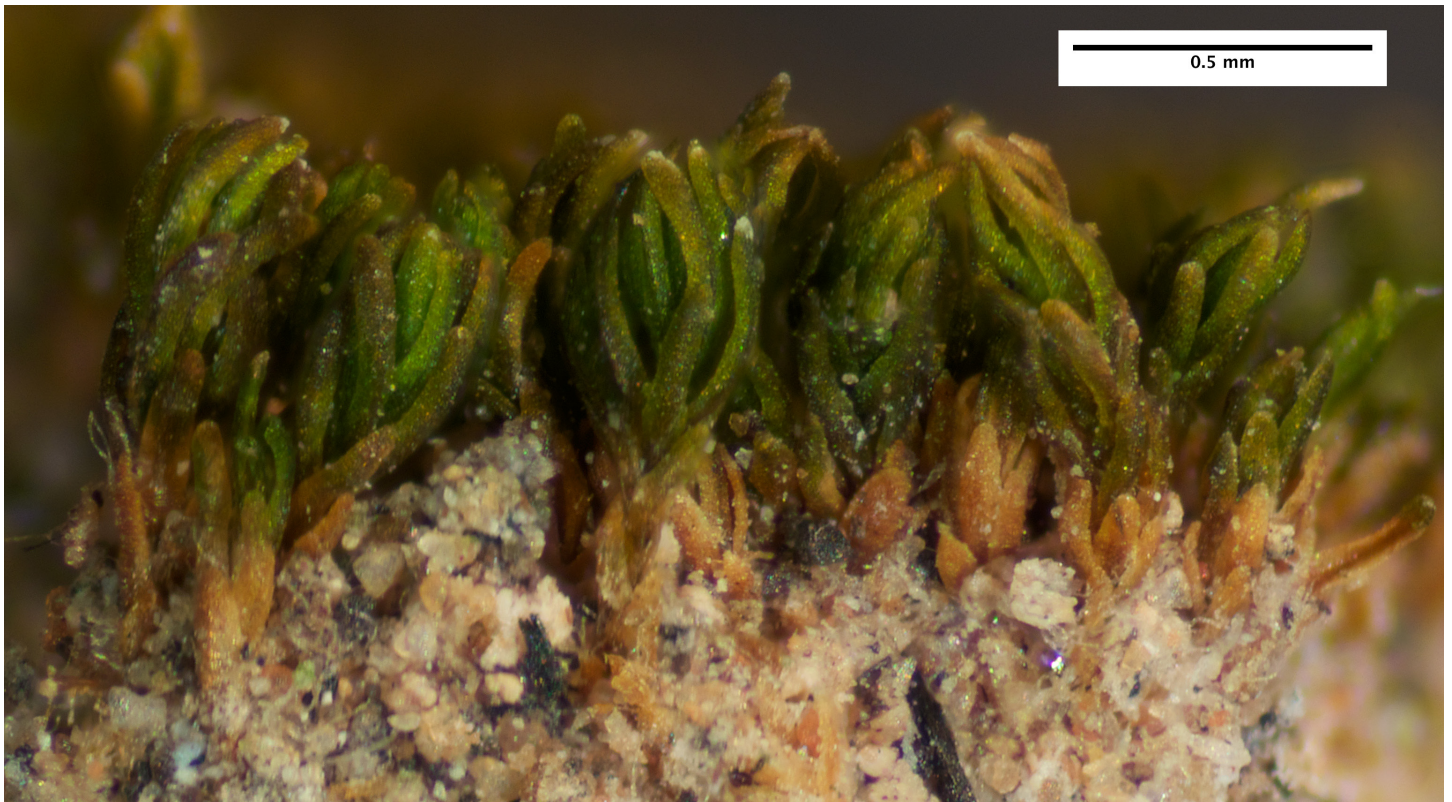


Figure 65. Habit, dry (Brinda, 1740)

*G. aeruginosum*100 μm *G. calcareum*50 μm *G. viridulum*50 μm

POTTIACEAE

Figure 66. Leaf (Brinda, 1740)**Figure 67.** Leaf (Brinda, 2029)**Figure 68.** Leaf (Brinda, 2008)

Pleurochaete luteola (Besch.) Thér.

Distribution: southern US to South America

Habitat: thin soil over calcareous rock (locally abundant on limestone ledges)

Distinctive Characters: large plants with undulate-crisped leaves; basal marginal cells strongly differentiated in a band that gradually tapers distally

Similar Species: *Tortella tortuosa* is similar but much smaller and its basal cells are differentiated the whole width of the leaf at its insertion.

Illustrations: figure 69, Eckel (2007)



Figure 69. Habit, dry (Brinda, 1962)

Tortella alpicola Dixon

Distribution: apparently widespread but actual distribution still not well known

Habitat: dry rock and rock crevices

Distinctive Characters: long, subulate leaf apices breaking off into several small pieces that serve as asexual propagules; stems with a central strand

Similar Species: The subulae of *T. fragilis* fall as a single piece and its stems lack a central strand.

Illustrations: figure 70, Eckel (1998)

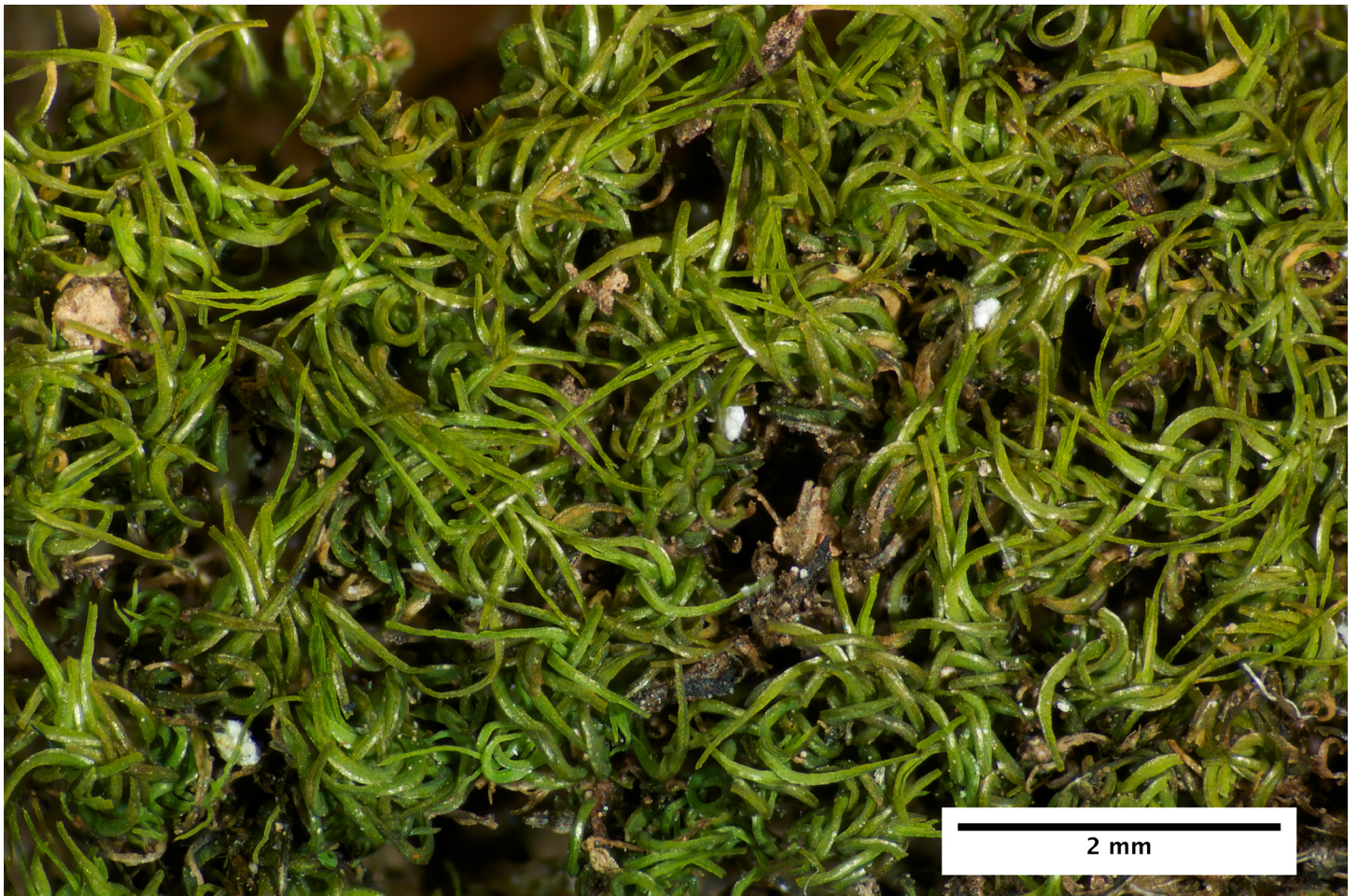


Figure 70. Habit, dry (Brinda, 1872)

Pottiopsis sweetii (E.B. Bartram) Ros & O. Werner

Distribution: southwestern US

Habitat: shaded soil and rock crevices

Distinctive Characters: autoicous; leaf margins $\pm$ plane to erect near the apex; sheathing perichaetial leaves; well-developed annulus

Similar Species: *Weissia* species are similar but have inrolled margins and the annulus is absent or poorly-developed.

Illustrations: figures 71-73, Flowers (1973, as *Weissia perligulata*)



Figure 71. Habit, dry (Brinda, 2027)



Figure 72. Leaf (Brinda, 2027)



Figure 73. Perichaetial leaf (Brinda, 2027)

Weissia andrewsii E.B. Bartram

Weissia ligulaefolia (E.B. Bartram) Grout

Distribution: southwestern US and adjacent Mexico

Habitat: shaded soil and rock crevices

Distinctive Characters: leaves incurved and contorted when dry, their margins inrolled; autoicous and often fruiting

Similar Species: The widespread *W. controversa* can be confused with *W. andrewsii* but its leaves are more lanceolate and the costa narrower.

Illustrations: figures 74-75 (*W. andrewsii*), Zander et al. (1994), figure 76 (*W. ligulaefolia*), Flowers (1973)

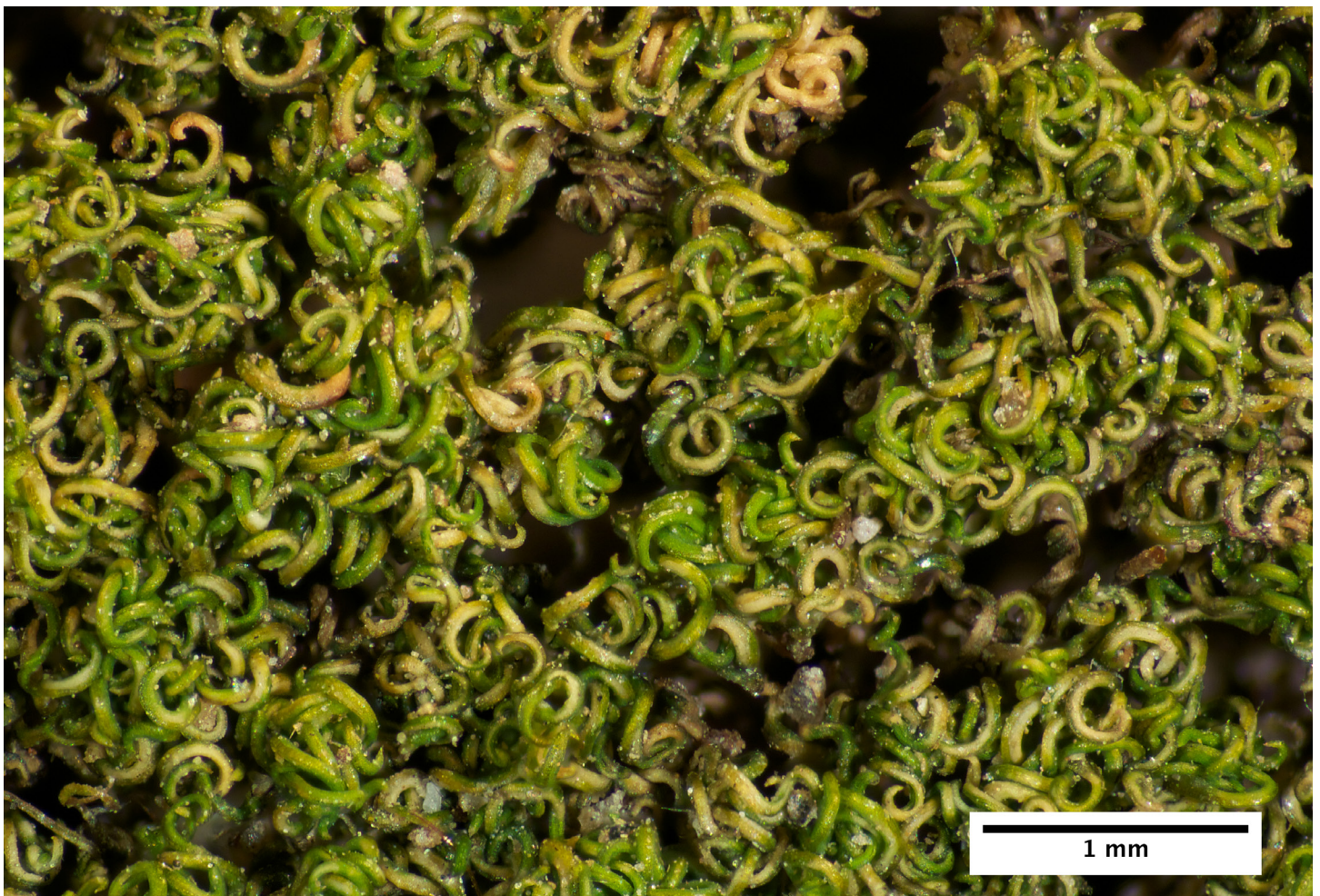


Figure 74. Habit, dry (Brinda, 1643)



Figure 75. Leaf of *W. andrewsii* (Brinda, 1643)



Figure 76. Leaf of *W. ligulaefolia* (Brinda, 2166)

Pseudocrossidium obtusulum (Lindb.) H.A. Crum & L.E. Anderson

Distribution: widespread but scattered in the northern hemisphere

Habitat: calcareous rock and soil

Distinctive Characters: tiny yellow-green plants with ovate leaves and revolute leaf margins

Similar Species: *Pseudocrossidium replicatum* also has revolute leaf margins but is larger and the leaves lingulate to oblong-lanceolate.

Illustrations: figure 77, Zander (2007a)



Figure 77. Habit, dry (Brinda, 2018)

Barbula unguiculata Hedw.

Distribution: sub-cosmopolitan

Habitat: on soil or gravel, often in disturbed areas

Distinctive Characters: leaves abruptly apiculate and contorted when dry

Similar Species: This plant could possibly be confused with species of *Tortula* but the leaves are more lanceolate.

Illustrations: figure 78, Flowers (1973)



Figure 78. Habit, dry (Brinda, 1894)

Bryoerythrophyllum recurvirostrum (Hedw.) P.C. Chen

Distribution: sub-cosmopolitan

Habitat: soil or rock

Distinctive Characters: large plants with distinct brick-red color and differentiated basal cells of the leaf

Similar Species: This plant could be confused with *Didymodon* species but the basal cells of the leaf are more strongly differentiated and the leaves are occasionally toothed near the apex.

Illustrations: figure 79, Flowers (1973)



POTTIACEAE

Figure 79. Habit, dry (Brinda, 1771)

Didymodon brachyphyllus (Sull.) R.H. Zander

Distribution: widespread but scattered

Habitat: soil and rock in arid regions

Distinctive Characters: plants with small ovate to ovate-lanceolate leaves and often bearing axillary gemmae

Similar Species: *Didymodon nicholsonii* is similar but lacks gemmae and the leaf is more strongly bistratose.

Illustrations: figure 80, Zander & Ochyra (2001)



Figure 80. Habit, dry (Brinda, 2057b)

Didymodon nicholsonii Culm.

Distribution: widespread in the northern hemisphere

Habitat: soil and rock (possibly preferring more neutral to acidic substrates, here found on basalt)

Distinctive Characters: bistratose leaves with blunt to broadly acute apices

Similar Species: *Didymodon eckeliae* also has bistratose leaves but they are long-lanceolate with narrowly acute apices.

Illustrations: figure 81, Smith (2004)



Figure 81. Habit, dry (Brinda, 1853)

Didymodon eckeliae R.H. Zander

Distribution: western North America and Europe but possibly more widespread

Habitat: soil over rock and the bases of trees

Distinctive Characters: long-lanceolate leaves with notched, bistratose margins

Similar Species: *Didymodon vinealis* is similar but the leaf margins are entire and usually unistratose.

Illustrations: figure 82, Zander (2001, 2007a)

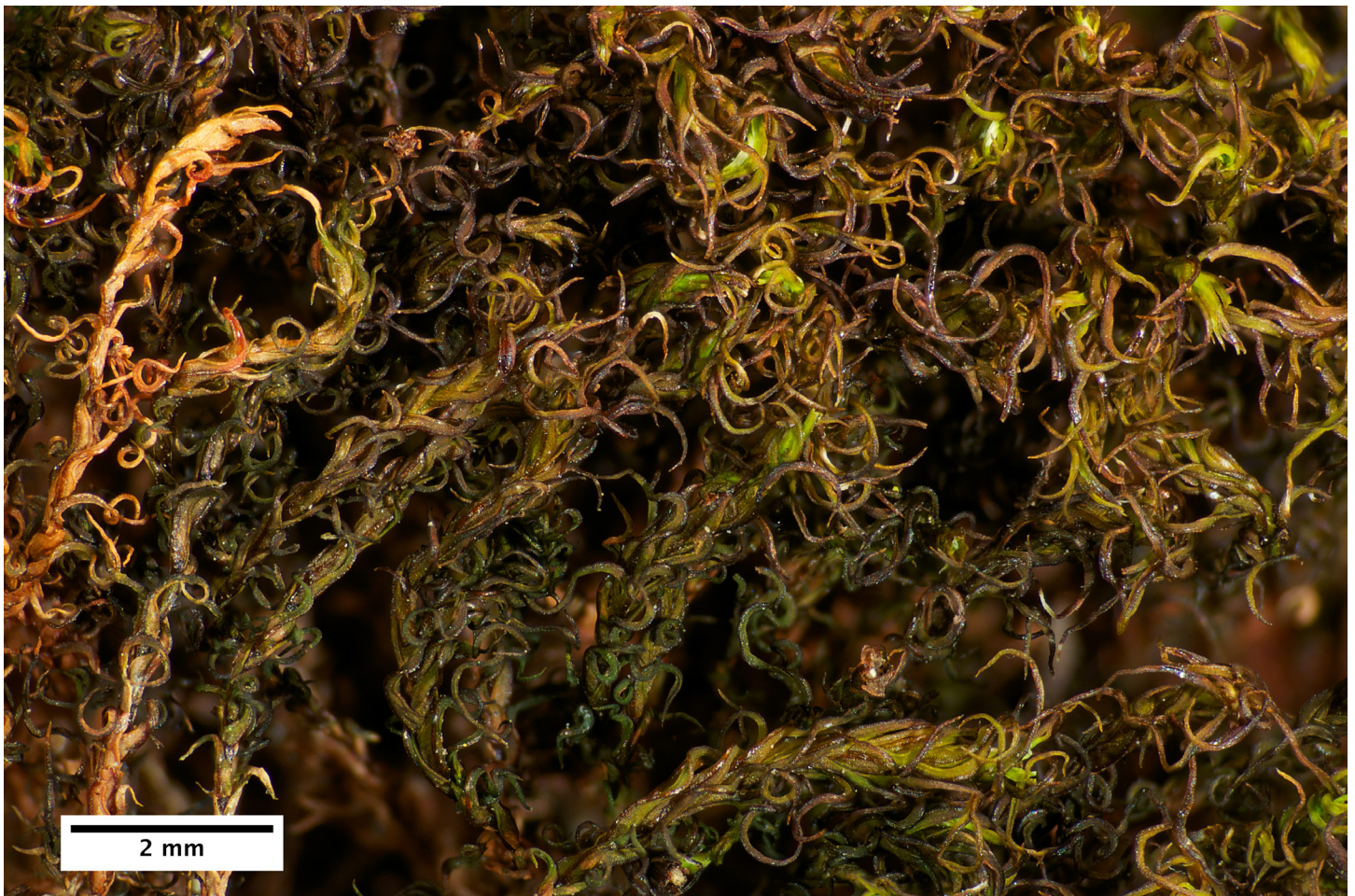


Figure 82. Habit, dry (Brinda, 1768)

Didymodon vinealis (Brid.) R.H. Zander

Distribution: widespread in the northern hemisphere

Habitat: soil and rock

Distinctive Characters: triangular leaf shape; apex acute and usually capped with a single clear, conical cell

Similar Species: Might be confused with *Ceratodon* but the laminal cells are usually papillose and it occurs in lower desert environments than *Ceratodon*.

Illustrations: figure 83, Zander et al. (1994)

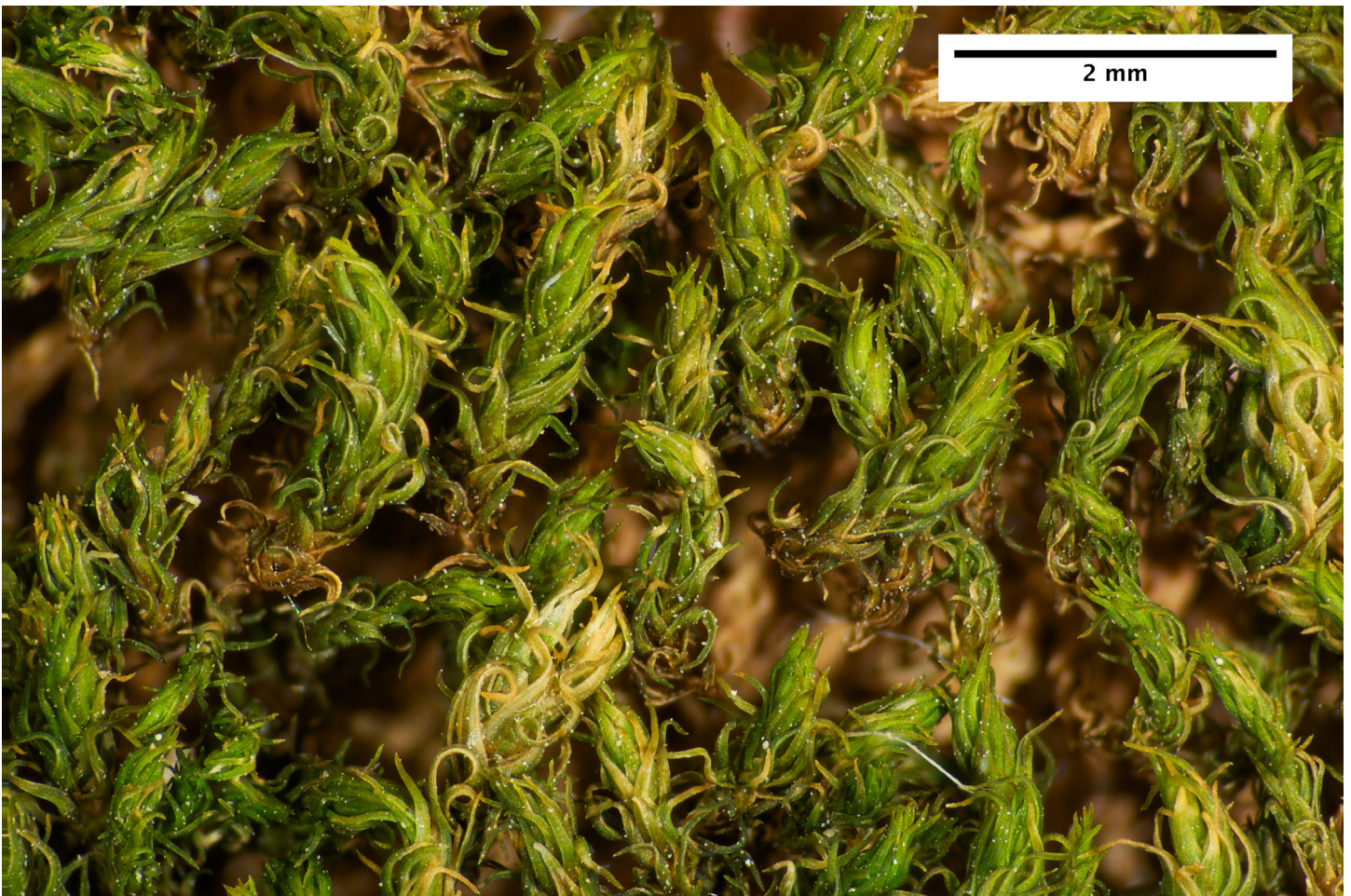


Figure 83. Habit, dry (Brinda, 2049)

Didymodon nevadensis R.H. Zander

Distribution: western North America

Habitat: in our area restricted to soils with a high gypsum content

Distinctive Characters: plants twisted in tight coils and bearing a large costal pad reminiscent of *Tortula atrovirens*

Similar Species: *Pseudocrossidium crinitum* has a similarly coiled appearance but its leaves bear stout awns. *Tortula atrovirens* has a similar costal pad but the plants are rosulate and regularly fruiting.

Illustrations: figure 84-85, Zander et al. (1995)



Figure 84. Habit, dry (Brinda, 2045)

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Figure 85. Field aspect (Brinda, 1650)

Didymodon rigidulus var. *icmadophilus* (Schimp. ex Müll. Hal.) R.H. Zander

Distribution: sub-cosmopolitan

Habitat: calcareous rock or sandy soil

Distinctive Characters: lanceolate leaves with the costa excurrent as a long subula

Similar Species: *Didymodon rigidulus* var. *gracilis* is similar but the subulae are shorter and more rigid.

Illustrations: figure 86, Zander et al. (1994)

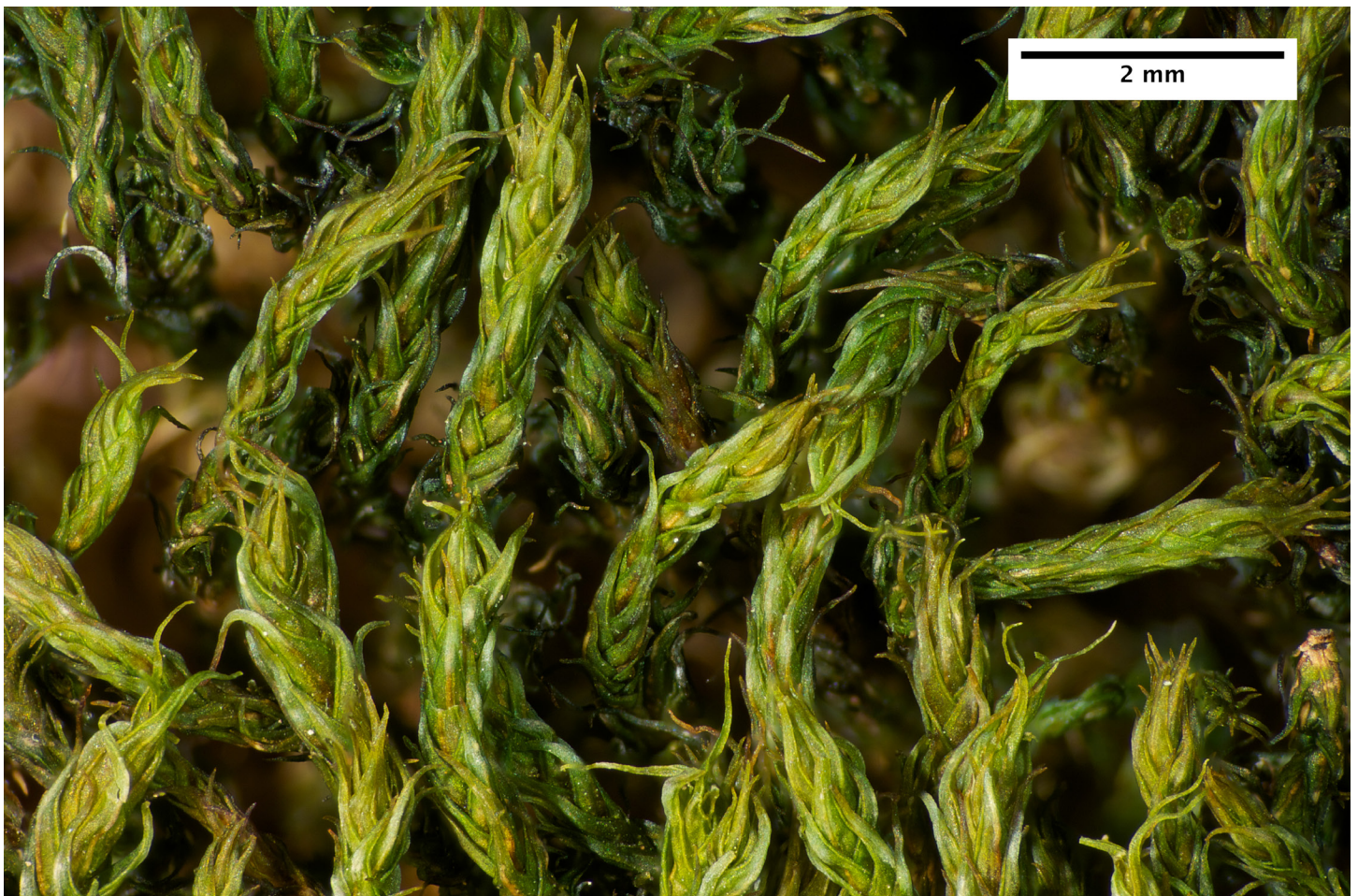


Figure 86. Habit, dry (Brinda, 2044)

Didymodon australasiae (Hook. & Grev.) R.H. Zander

Distribution: sub-cosmopolitan

Habitat: soil and rock ledges (here more common in low desert environments)

Distinctive Characters: small, blackish-green plants with distinctly spirally twisted leaves

Similar Species: *Didymodon umbrosus* is similar but the leaves are long-lanceolate, smooth or weakly papillose, and with differentiated basal marginal cells.

Illustrations: figure 87, Zander et al. (1994)



Figure 87. Habit, dry (Brinda, 1661)

Didymodon tophaceus (Brid.) Lisa

Distribution: sub-cosmopolitan

Habitat: wet seeps and springs

Distinctive Characters: blunt-leaved plants often growing in tufaceous deposits around springs

Similar Species: *Gymnostomum* and *Eucladium* also form tufaceous deposits but their leaves are generally more lanceolate.

Illustrations: figure 88-89, Zander et al. (1994)



Figure 88. Dry habit, showing calcium deposits on old leaves (Brinda, 1642)



POTTIACEAE

Figure 89. Field aspect (Brinda, 1642)

Aloina ambigua (Bruch & Schimp.) Limpr.

Distribution: sub-cosmopolitan

Habitat: calcareous rock and soil in arid regions

Distinctive Characters: thick, succulent leaves with ventral surface covered in filaments; hairpoint absent

Similar Species: *Aloina rigida* is similar but has differentiated basal marginal cells. The European *A. aloides* differs in sporophytic characters.

Illustrations: figures 90-91, Smith (2004)



Figure 90. Habit, dry (Brinda, 2024)



Figure 91. Habit, wet (Brinda, 2024)

Aloina bifrons (De Not.) Delgad.

Distribution: sub-cosmopolitan

Habitat: soil in arid regions (here preferring strongly calcareous soils such as gypsum)

Distinctive Characters: thick, succulent leaves with ventral surface covered in filaments; hairpoint present

Similar Species: *Crossidium* species have hairpoints but the filaments on their leaves emanate from a narrower costa.

Illustrations: figure 92, Flowers (1973)



Figure 92. Habit, dry (Brinda, 1652)

Syntrichia virescens (De Not.) Ochyra

Distribution: widespread in the northern hemisphere (but generally not recognized as occurring in North America)

Habitat: here usually a species of rock crevices and shaded rock overhangs at mid elevations

Distinctive Characters: small, blackish-green plants with weakly recurved margins, weak costal stereid band, and lacking hydroids

Similar Species: *Syntrichia bartramii* is similar but its lamina is bistratose in patches.

Illustrations: figure 93, Kramer (1988)



POTTIACEAE

Figure 93. Habit, dry (Brinda, 1795)

Syntrichia pagorum (Milde) J.J. Amann

Distribution: sub-cosmopolitan

Habitat: usually epiphytic but occasionally on rock or soil

Distinctive Characters: rosulate plants bearing many small brood leaves at the stem apices; dioicous

Similar Species: *Syntrichia laevipila* is closely related but is autoicous and typically lacks brood leaves.

Illustrations: figure 94-95, Zander et al. (1994)



Figure 94. Habit, dry (Brinda, 2211)

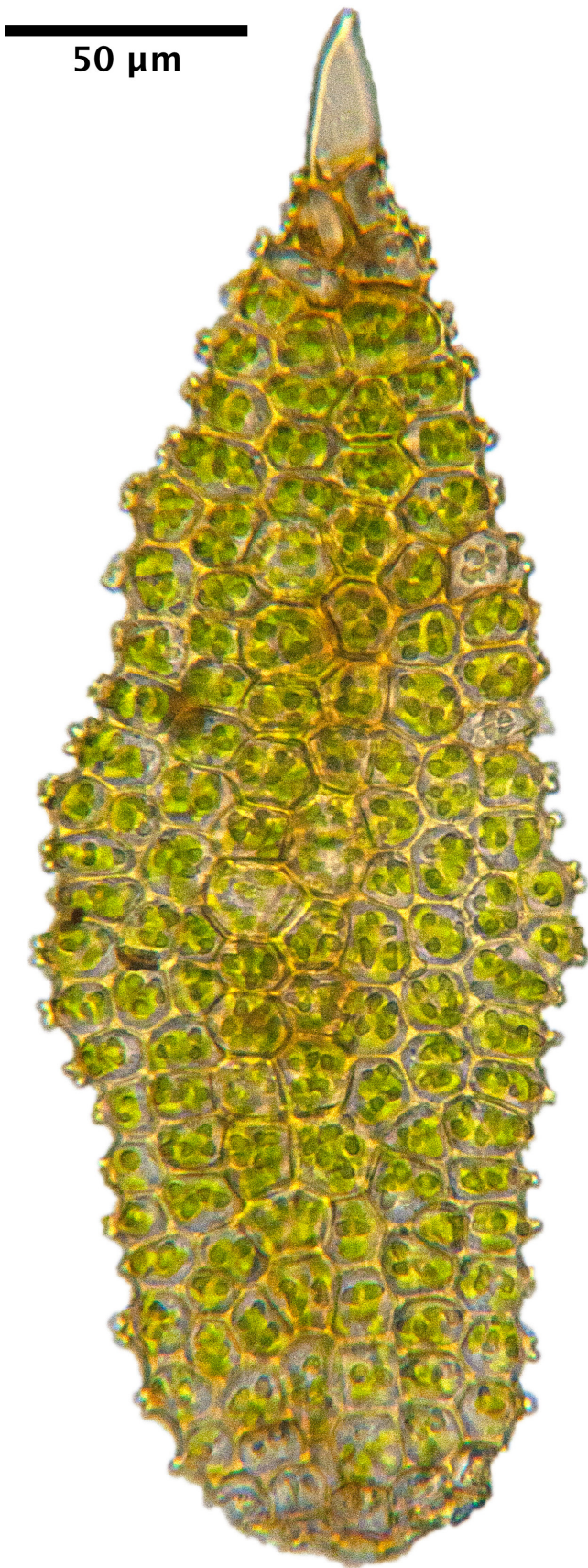


Figure 95. Brood leaf (Brinda, 2211)

Syntrichia laevipila Brid.

Distribution: sub-cosmopolitan

Habitat: bark of trees (here found on decaying wood)

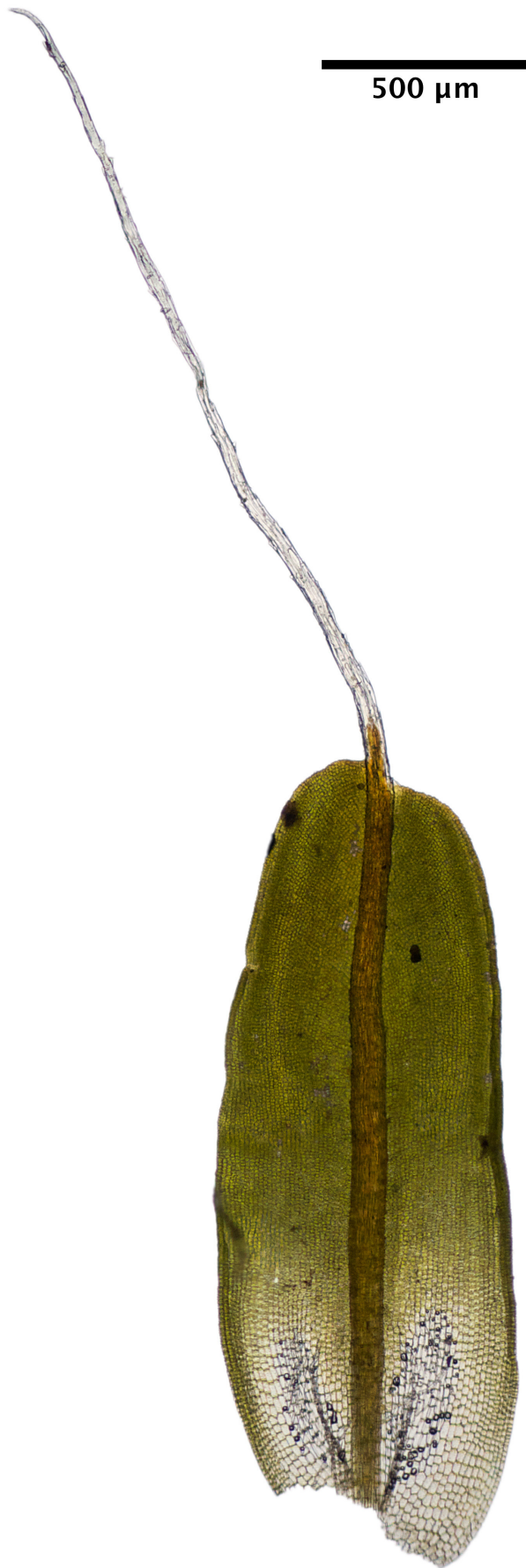
Distinctive Characters: epiphytic habit and the long, smooth to faintly spinose awn

Similar Species: *Syntrichia papillosa* is also epiphytic and blackish-green but bears spherical gemmae on the adaxial costal surface and the cells are unipapillose only on the abaxial surface.

Illustrations: figures 96-97, Zander (1993)



Figure 96. Habit, dry (Brinda, 1923)



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Figure 97. Leaf (Brinda, 1923)

Syntrichia caninervis Mitt.

Distribution: sub-cosmopolitan

Habitat: calcareous soils

Distinctive Characters: bistratose lamina; costa with substereids; dorsal surface of costa near apex with tall papillae

Similar Species: Depauperate *S. ruralis* differs in costal anatomy and has unistratose leaves.

Illustrations: figure 98, Mishler (2007)



Figure 98. Habit, dry (Brinda, 1671)

Syntrichia ruralis (Hedw.) F. Weber & D. Mohr

Distribution: sub-cosmopolitan

Habitat: soil, thin soil on rocks, and the bases of trees

Distinctive Characters: leaves spirally twisted when dry and rather strongly squarrose-recurved when moist

Similar Species: *Syntrichia papillosissima* is larger and has very tall antleroid papillae.

Illustrations: figure 99, Crum & Anderson (1981)



Figure 99. Habit, dry (Brinda, 2082)

Syntrichia papillosissima (Copp.) Loeske

Distribution: widespread in the northern hemisphere

Habitat: soil and rock

Distinctive Characters: large plants with tall antleroid papillae creating a glaucous or frosted appearance

Similar Species: The recently described *Syntrichia sucrosa* also bears pedicellate papillae but has hydroids in its costa.

Illustrations: figures 100-101, Flowers (1973)

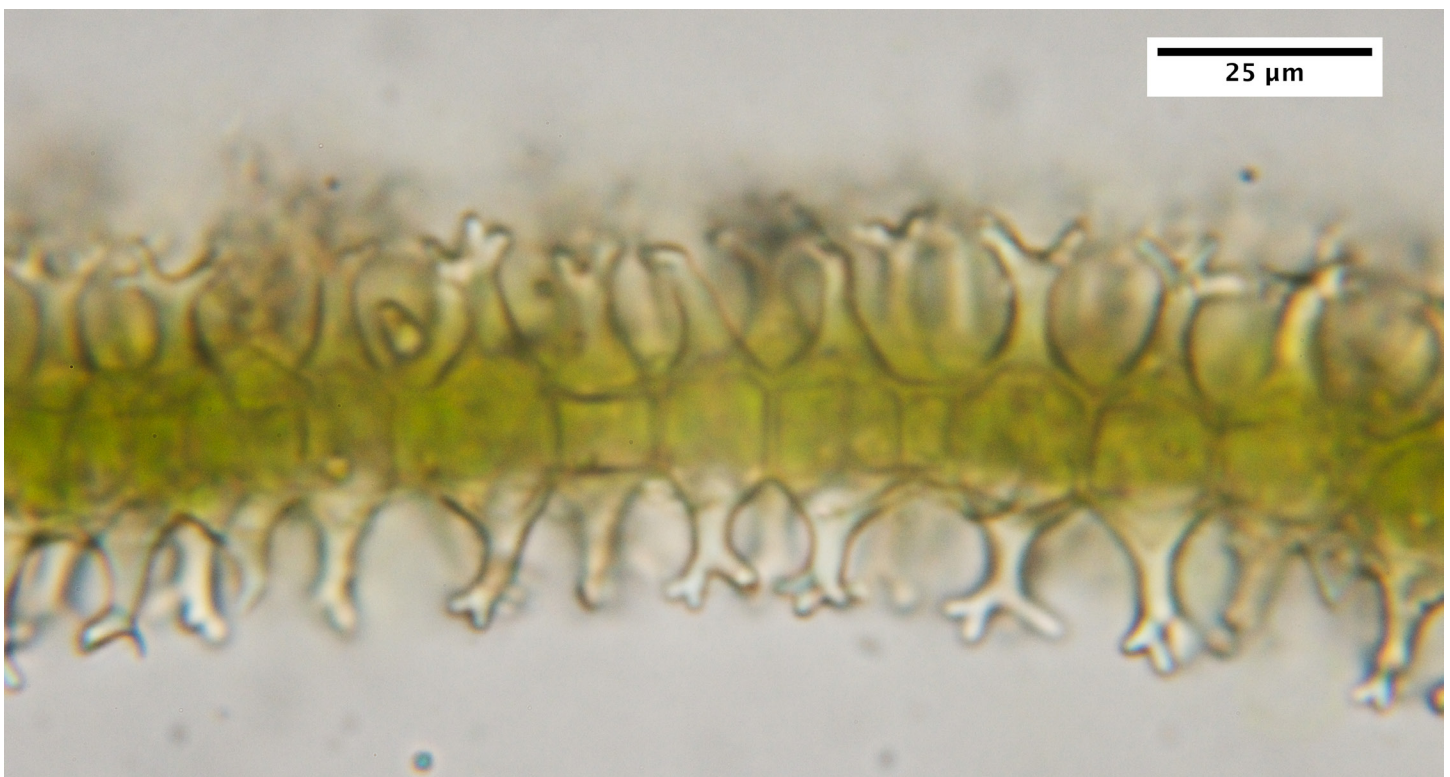


Figure 100. Cross-section of leaf lamina showing the tall, antleroid papillae (Brinda, 2209)

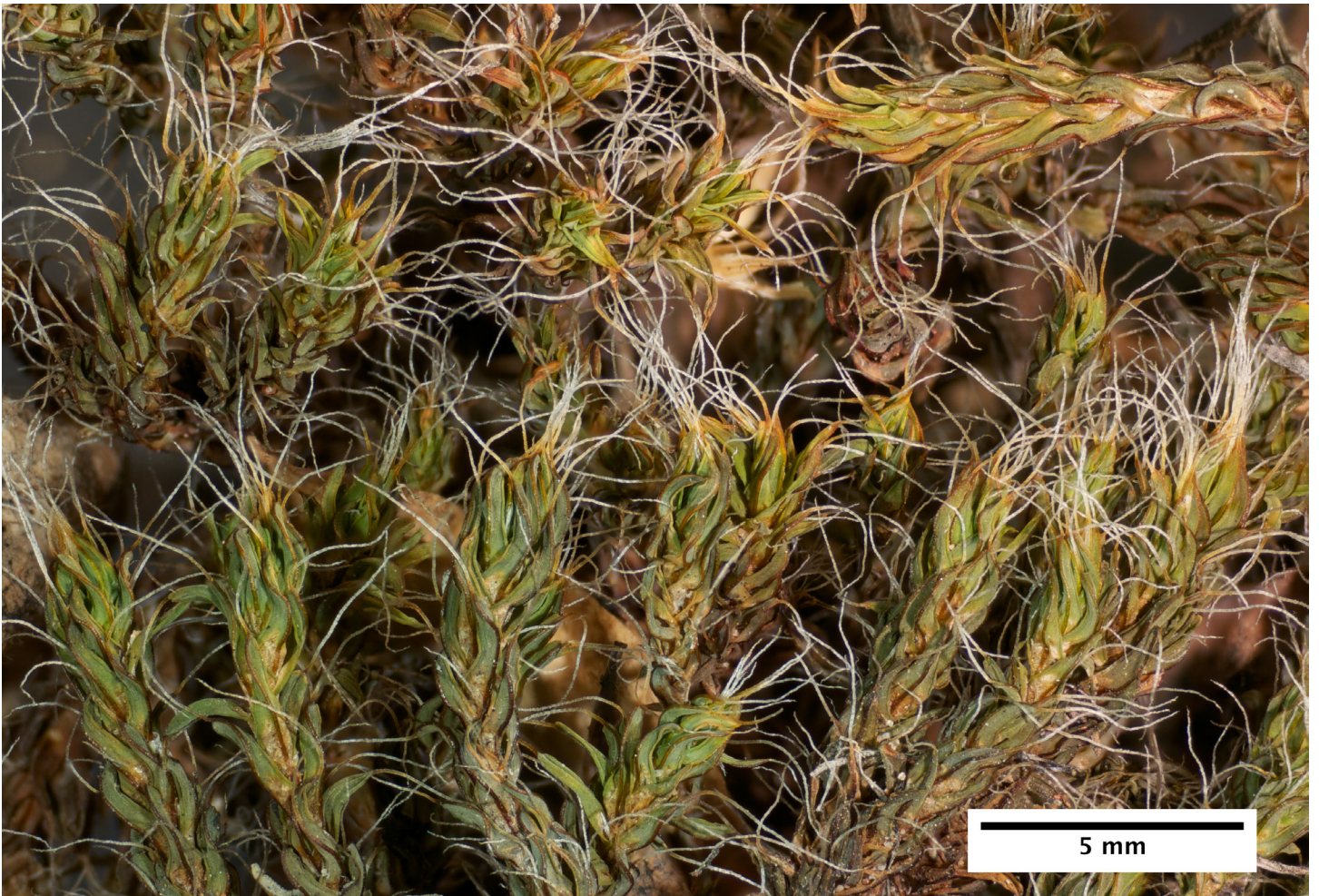


Figure 101. Habit, dry (Brinda, 2209)

Syntrichia princeps (De Not.) Mitt.

Distribution: sub-cosmopolitan

Habitat: various substrates, here found mostly on soil

Distinctive Characters: large cell size, synoicous inflorescence, lingulate leaves, and costa with hydroids

Similar Species: *Syntrichia obtusissima* also has large cells but is autoicous and the back of the costa is $\pm$ smooth.

Illustrations: figures 102-104, Flowers (1973)



Figure 102. Leaf (Brinda, 1644)

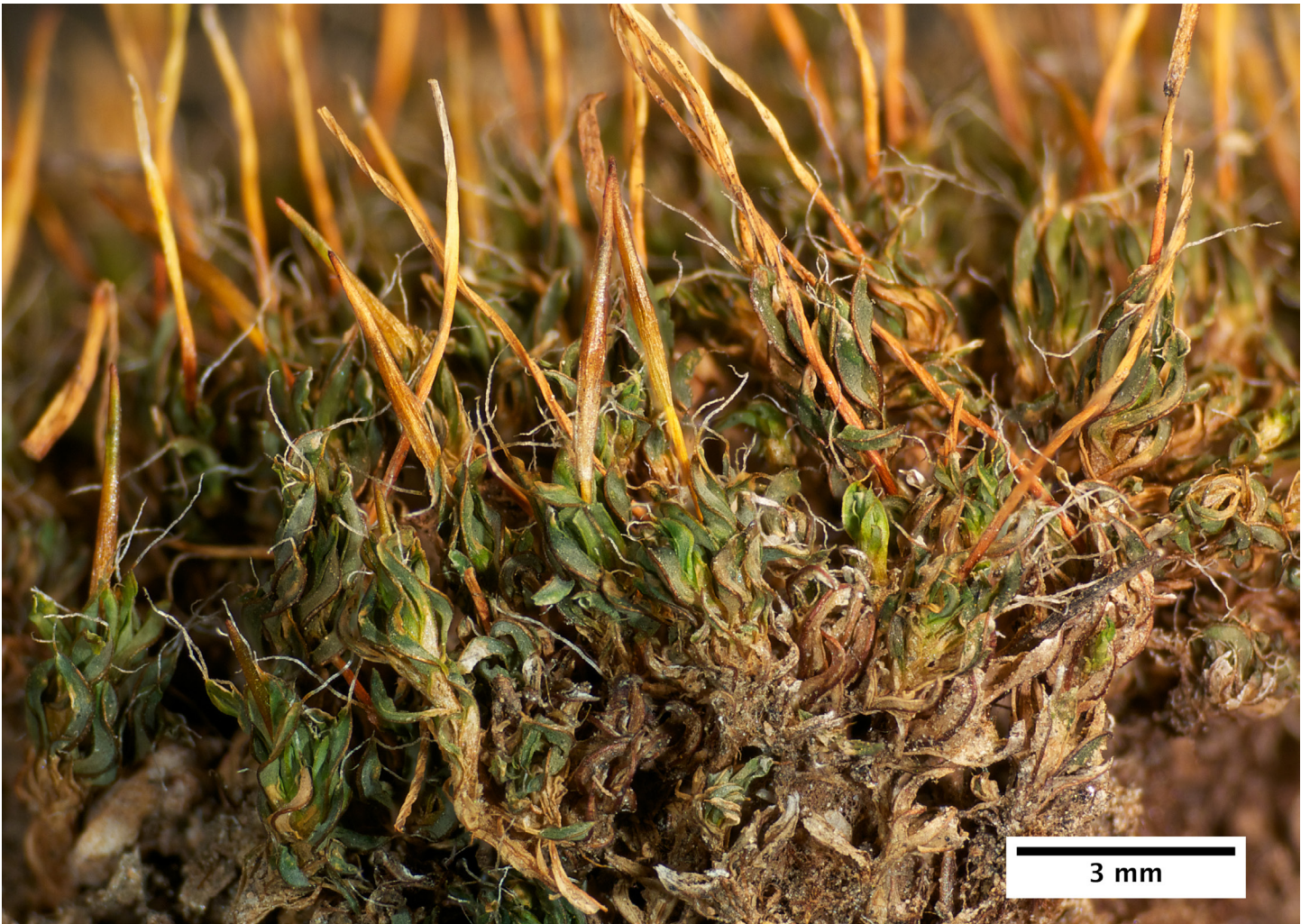


Figure 103. Habit, dry (Brinda, 1644)



Figure 104. Synoicous inflorescence (Brinda, 1644)

Syntrichia calcicola J.J. Amann

Distribution: widespread in the northern hemisphere (but generally not recognized as occurring in North America)

Habitat: on soil or rock (here found at higher elevations in forested areas)

Distinctive Characters: a weak costal stereid band making the leaves flexuose when dry and only patent to spreading when moist

Similar Species: *Syntrichia norvegica* is also found at higher elevations but it differs in its red hairpoints and the costal stereid band becoming so weak that near the leaf apex it often completely disappears.

Illustrations: figure 105, Kramer (1988)

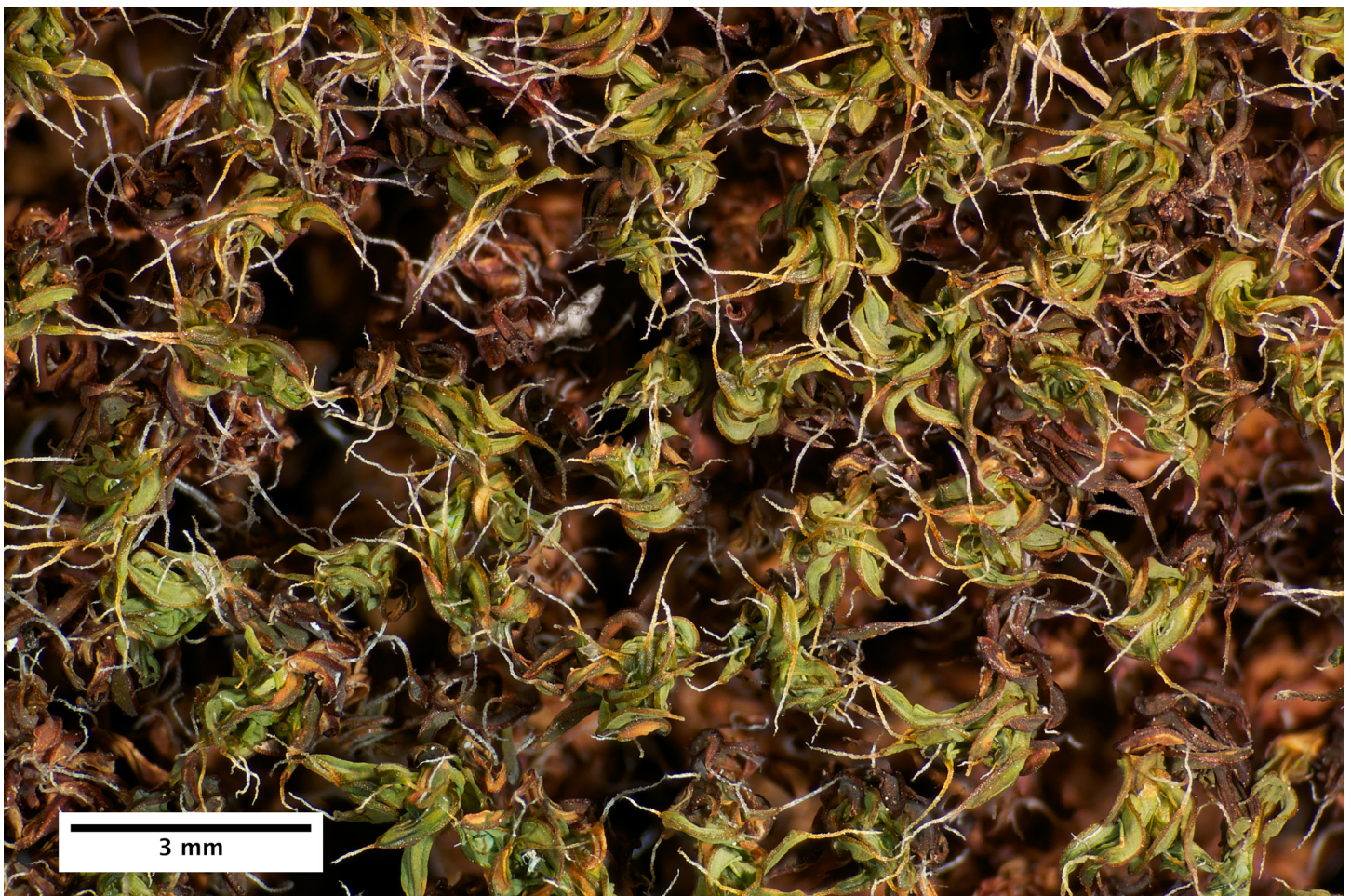


Figure 105. Habit, dry (Brinda, 2129)

Microbryum starckeanum var. *brachyodus* (Bruch & Schimp.) R.H. Zander

Distribution: arid regions in the northern hemisphere

Habitat: calcareous soil

Distinctive Characters: small, scattered, sporophytic plants on soil; reddish in 2% KOH solution

Similar Species: Small *Tortula* species are similar but actually not closely related. *Microbryum* is separated most easily by its reddish reaction to a 2% KOH solution.

Illustrations: figure 106, Zander (2007b)



POTTIACEAE

Figure 106. Habit, dry (Brinda, 1676)

Phascum cuspidatum Hedw.

Distribution: sub-cosmopolitan

Habitat: on soil, often in disturbed areas

Distinctive Characters: ephemeral plants with immersed, cleistocarpous capsules

Similar Species: *Stegonia hyalinotricha* is similar but has whitish leaves like *Bryum argenteum*.

Illustrations: figures 107-108, Flowers (1973)



Figure 107. Sporophyte (Brinda, 1895)



Figure 108. Habit, dry (Brinda, 1895)

Tortula inermis (Brid.) Mont.

Distribution: widespread in the northern hemisphere

Habitat: soil or rock (seems to prefer less calcareous substrates here)

Distinctive Characters: lingulate leaves without hairpoint that are strongly twisted around the stem when dry

Similar Species: *Tortula mucronifolia* is similar but its cells are smooth or very weakly papillose and the leaves usually have a short, yellowish mucro of variable length.

Illustrations: figure 109, Flowers (1973)



Figure 109. Habit, dry (Brinda, 1734)

Tortula mucronifolia Schwägr.

Distribution: widespread in the northern hemisphere

Habitat: soil or rock

Distinctive Characters: lingulate leaves with short yellowish mucro that are strongly twisted around the stem when dry; the leaves are shiny-green in contrast to the dull-green of *T. inermis*

Similar Species: *Tortula subulata* is similar but its cells are more papillose and its leaves are bordered by thicker-walled cells.

Illustrations: figure 110, Flowers (1973)



Figure 110. Habit, dry (Brinda, 1635)

Tortula atrovirens (Sm.) Lindb.

Distribution: sub-cosmopolitan

Habitat: soil and rock

Distinctive Characters: small, rosulate plants with brownish leaves strongly twisted around the stem when dry; the massive costal pad is easily visible when wet

Similar Species: Superficially similar to *Aloina ambigua* when dry, although in that species the leaves are incurved, not spirally twisted around the stem.

Illustrations: figures 111-112, Zander (1993)



Figure 111. Habit, dry (Brinda, 1718)



POTTIACEAE

Figure 112. Leaf (Brinda, 1718)

Tortula muralis Hedw.

Tortula brevipes (Lesq.) Broth.

Distribution: sub-cosmopolitan (*T. muralis*), western North America (*T. brevipes*)

Habitat: rock (*T. muralis*), soil (*T. brevipes*)

Distinctive Characters: small plants on calcareous substrates with long, smooth, hyaline awns

Similar Species: *Tortula brevipes* is segregated from *T. muralis* based on the high basal membrane of its peristome and its preference for soil as a substrate. *Tortula plinthobia* is similar but has a reduced peristome of only 16 teeth and is found in fruit less frequently.

Illustrations: figure 113 (*T. muralis*), figure 114 (*T. brevipes*), Flowers (1973)



Figure 113. Habit, dry (Brinda, 2188)



Figure 114. Sporophyte of *T. brevipes* showing high basal membrane (Brinda, 1690)

Crossidium seriatum H.A. Crum & Steere

Distribution: western North America (reports from Europe are probably referable to *Tortula brevissima*)

Habitat: here restricted to highly calcareous soil (gypsum and tufa deposits of ancient springs)

Distinctive Characters: pluripapillose cells combined with a pad of loose cells on the costa much like in *Crossidium aberrans*

Similar Species: This species is probably related to *T. muralis* but the costal pad of loose cells is more like that found in *Crossidium*.

Illustrations: figures 115-116, Delgadillo M. (2007)



Figure 115. Habit, dry (Brinda, 1669)



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Figure 116. Leaf (Brinda, 1669)

Crossidium aberrans Holz. & E.B. Bartram

Distribution: widespread but scattered in the northern hemisphere

Habitat: soil and rock in arid regions

Distinctive Characters: cells smooth or with weak, simple papillae; costal pad of loose cells forming short filaments

Similar Species: *Crossidium seriatum* is similar but the cells are clearly pluripapillose.

Illustrations: figures 117-118, Zander et al. (1994)



Figure 117. Habit, dry (Brinda, 2010a)

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Figure 118. Leaf, showing filaments (Brinda, 2010a)

Crossidium crassinerve (De Not.) Jur.

Distribution: widespread in the northern hemisphere

Habitat: soil and rock in arid regions

Distinctive Characters: leaves with long filaments borne on the costa; upper laminal cells not much differentiated

Similar Species: *Crossidium squamiferum* also has long filaments but its upper laminal cells have very thick walls.

Illustrations: figures 119-120, Delgadillo M. (2007)



Figure 119. Leaf apex, showing filaments (Brinda, 1723a)



Figure 120. Leaf, showing filaments (Brinda, 1723a)

Crossidium squamiferum (Viv.) Jur. var. *squamiferum*

Distribution: widespread in the northern hemisphere

Habitat: soil and rock in arid regions

Distinctive Characters: leaves with long filaments borne on the costa; upper laminal cells differentiated with very thick cell walls obscuring the lumen; basal marginal cells elongate; seta > 7 mm and capsule cylindric

Similar Species: The variety *pottioideum* has a shorter seta, ovoid-cylindric capsule, and lacks the elongate cells of the basal margin.

Illustrations: figures 121-122, Delgadillo M. (1975)

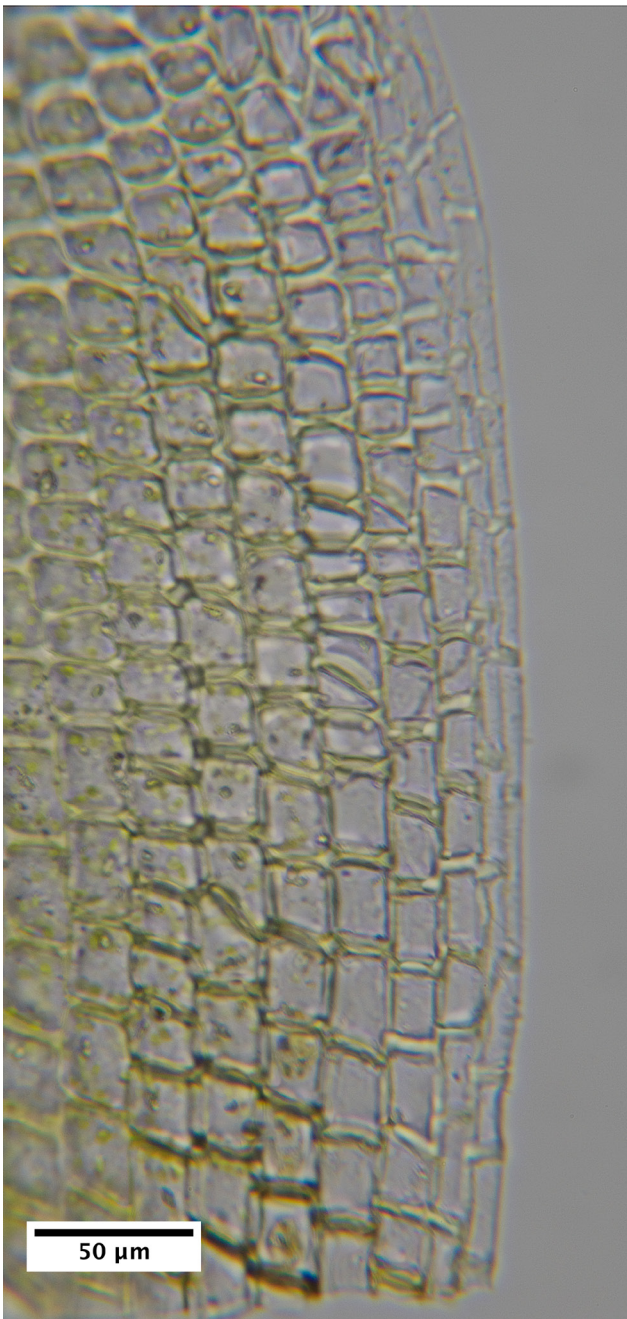


Figure 121. Basal marginal cells of leaf (Brinda, 2032)



Figure 122. Sporophyte (Brinda, 2032)

Crossidium squamiferum var. *pottioideum* (De Not.) Mönk.

Distribution: widespread in the northern hemisphere

Habitat: soil and rock in arid regions

Distinctive Characters: leaves with long filaments borne on the costa; upper laminal cells differentiated with very thick cell walls obscuring the lumen; basal marginal cells not differentiated; seta 5-8 mm and capsule ovoid-cylindric

Similar Species: The bulbiform plants with succulent leaves are superficially similar to *Pterygoneurum* species but the leaves of *Pterygoneurum* bear lamellae.

Illustrations: figures 123-124, Delgadillo M. (1975)



Figure 123. Sporophyte (Brinda, 1584)

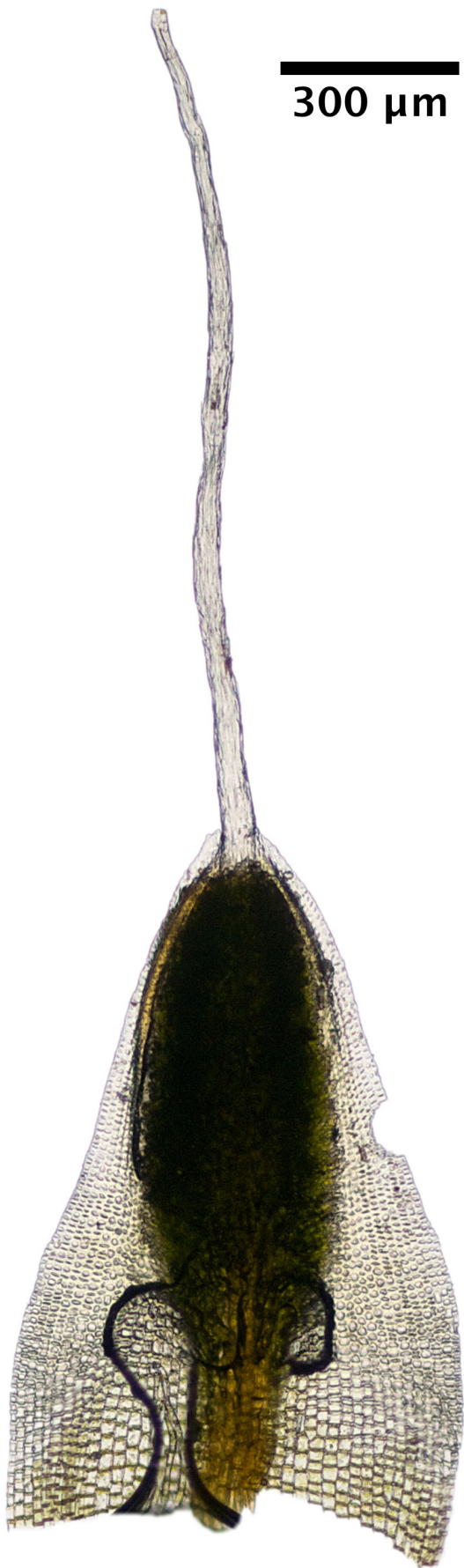


Figure 124. Leaf (Brinda, 1584)

Pterygoneurum ovatum (Hedw.) Dixon

Pterygoneurum sessile (Brid.) Jur.

Distribution: sub-cosmopolitan

Habitat: on soil

Distinctive Characters: small bulbiform plants with succulent leaves bearing lamellae on the costa; usually forming dense, hoary turfs on exposed soil

Similar Species: In *P. sessile* the capsules are immersed on very short setae.

Illustrations: figure 125 (*P. ovatum*), figure 126 (*P. cf. sessile*), Flowers (1973)



Figure 125. Dry habit, showing emergent sporophyte (Brinda, 1896)



Figure 126. Leaf (Brinda, 1668)

Desmatodon guepinii Bruch & Schimp.

Distribution: western North America and Europe

Habitat: on soil at low elevations

Distinctive Characters: small *Tortula*-like plants with a stout yellow to orangish awn; species of *Desmatodon* have a peristome of 16 teeth that become divided into filaments above

Similar Species: This species is smaller and the leaf border less papillose than in *Desmatodon latifolius*.

Illustrations: figures 127-128, Zander et al. (1994)

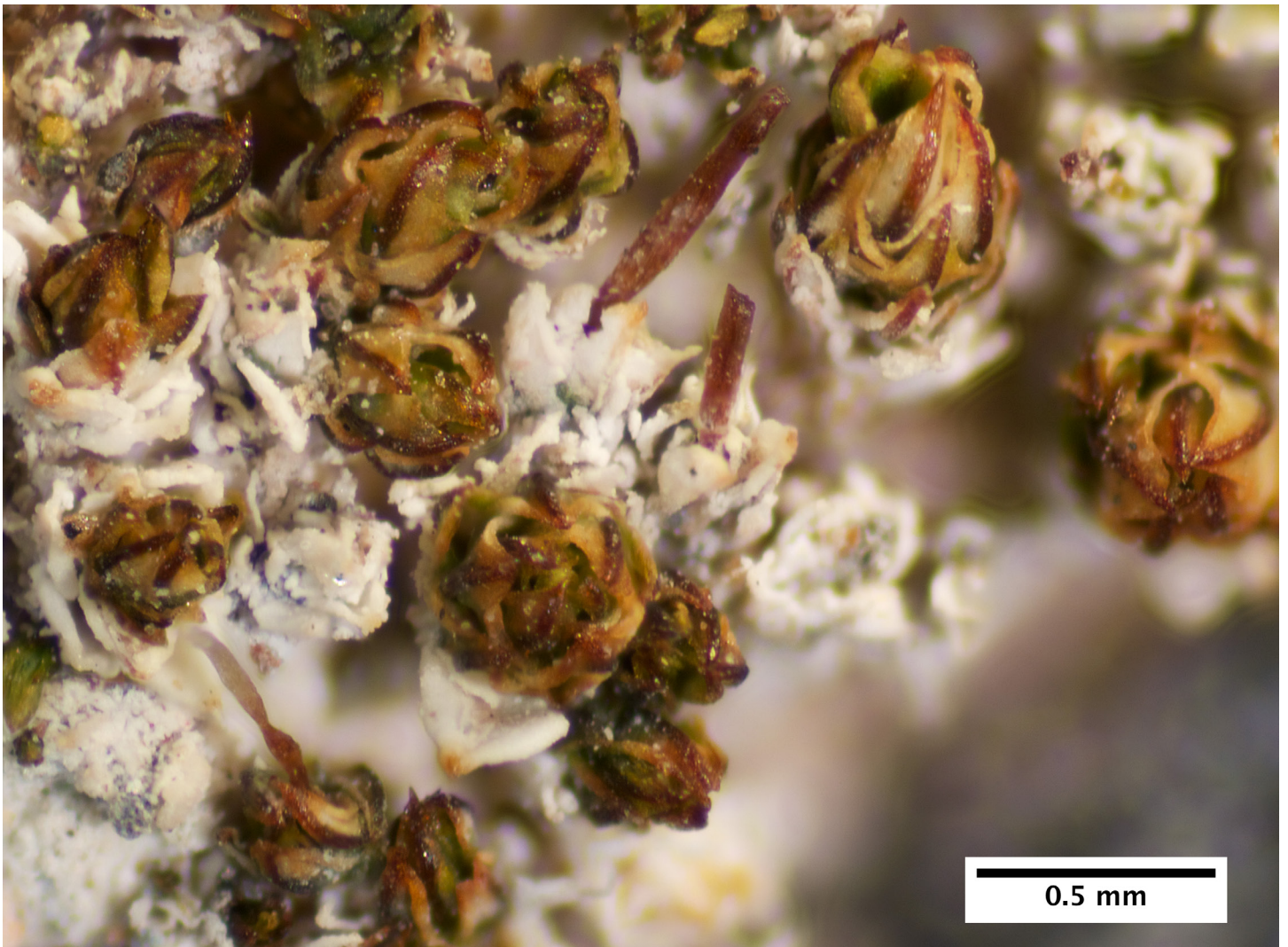


Figure 127. Habit, dry (Brinda, 1662b)



Figure 128. Leaf (Brinda, 1662b)

Hedwigia nivalis (Müll. Hal.) Mitt.

Distribution: widespread, but with a more southern distribution

Habitat: here restricted to basalt outcrops at higher elevations

Distinctive Characters: blue-green plants with bright white leaf tips; immersed capsules with ciliate perichaetial leaves

Similar Species: *Hedwigia detonsa* of California is similar but has entire perichaetial leaves.

Illustrations: figures 129-131, Allen (2010)



Figure 129. Habit, dry (Brinda, 2104)



Figure 130. Leaf (Brinda, 2104)



Figure 131. Apex of perichaetial leaf (Brinda, 2104)

Anacolia menziesii (Turner) Paris var. *menziesii*

Distribution: western North America

Habitat: rock or thin soil over rock

Distinctive Characters: clusters of dark rhizoids obscuring the stem; long-lanceolate, appressed leaves; stems somewhat curved when dry

Similar Species: While difficult to distinguish gametophytically, *Anacolia baueri* has smaller spores, a more cylindric capsule, and a different chromosome number.

Illustrations: figure 132, Flowers (1952)

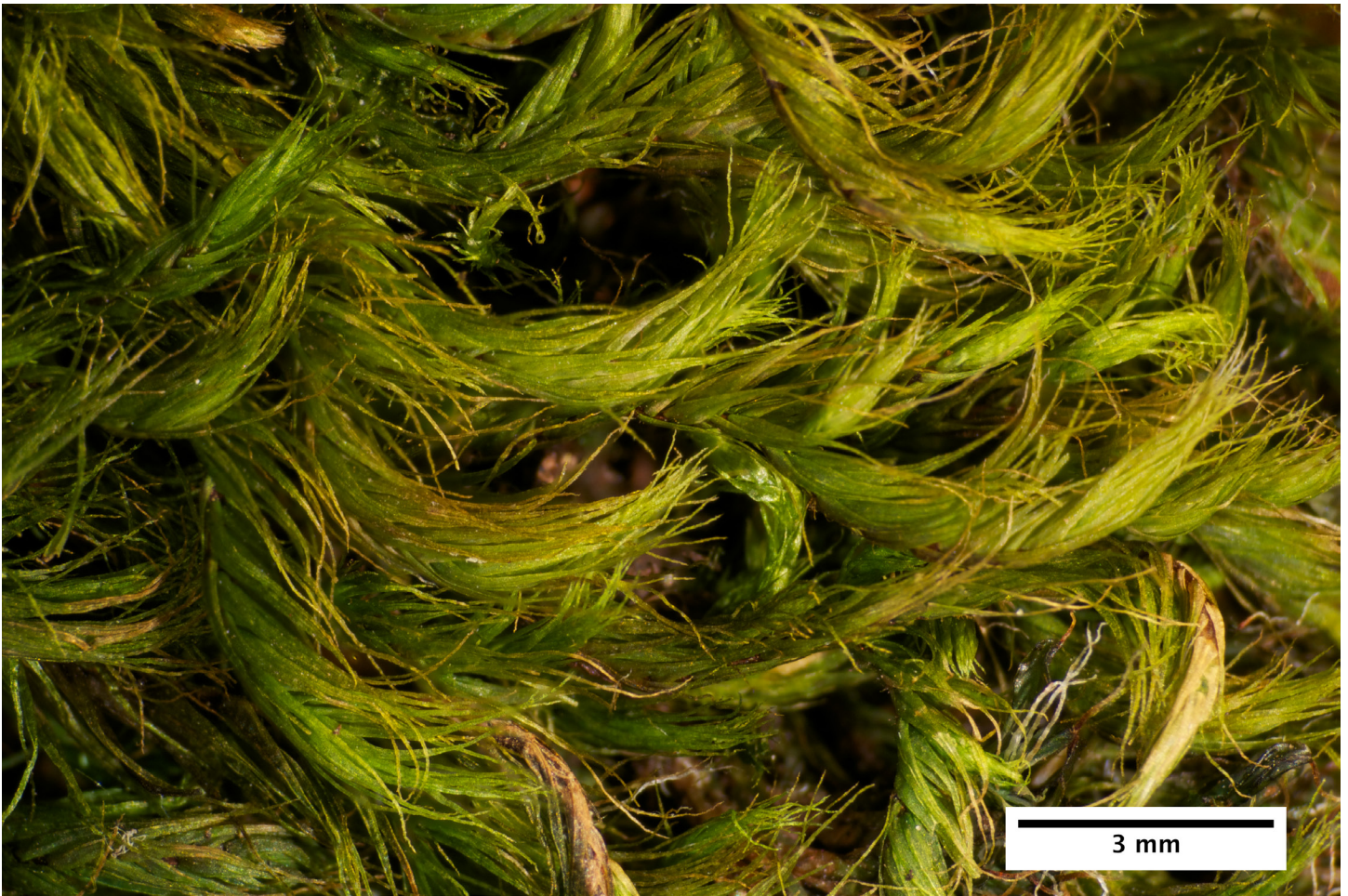


Figure 132. Habit, dry (Brinda, 1765)

Rosulabryum capillare (Hedw.) J.R. Spence

Distribution: sub-cosmopolitan

Habitat: on shaded soil or rotting wood

Distinctive Characters: bordered, obovate leaves that are twisted around the stem when dry

Similar Species: *Rosulabryum flaccidum* is similar but bears filiform gemmae in the leaf axils and the leaves are not twisted around the stem when dry.

Illustrations: 133-134, Syed (1973), Zolotov (2000)



Figure 133. Habit, dry (Brinda, 1693)



Figure 134. Dry habit, showing characteristic twisted leaves (Brinda, 1693)

Rosulabryum flaccidum (Brid.) J.R. Spence

Distribution: North America

Habitat: here found mainly on shaded rock or soil

Distinctive Characters: plants with filiform gemmae in the leaf axils and ovate leaves

Similar Species: *Rosulabryum laeviflum* is similar but is usually found on bark and has obovate leaves.

Illustrations: figure 135, Spence (2011b)



Figure 135. Habit, dry (Brinda, 1832)

Imbribryum gemmiparum (De Not.) J.R. Spence

Distribution: North America and Mediterranean Europe

Habitat: calcareous springs and seeps

Distinctive Characters: dense turfs of yellow-green plants with broadly acute, imbricate leaves usually associated with desert seeps and springs

Similar Species: *Plagiobryoides* species are also found in springs (especially hot springs) but their areolation is more lax and the leaves are not imbricate when dry.

Illustrations: figure 136, Flowers (1973)



Figure 136. Habit, dry (Brinda, 1628)

Bryum argenteum Hedw.

Distribution: truly cosmopolitan (found on all seven continents)

Habitat: soil, soil over rock, or rock crevices (often in disturbed areas)

Distinctive Characters: whitish or silvery appearance due to hyaline upper lamina; leaves apiculate but the costa not reaching the apex

Similar Species: In *B. lanatum* the costa is excurrent as a stout awn that is $\pm$ recurved when dry.

Illustrations: figure 137, Spence (2011a)

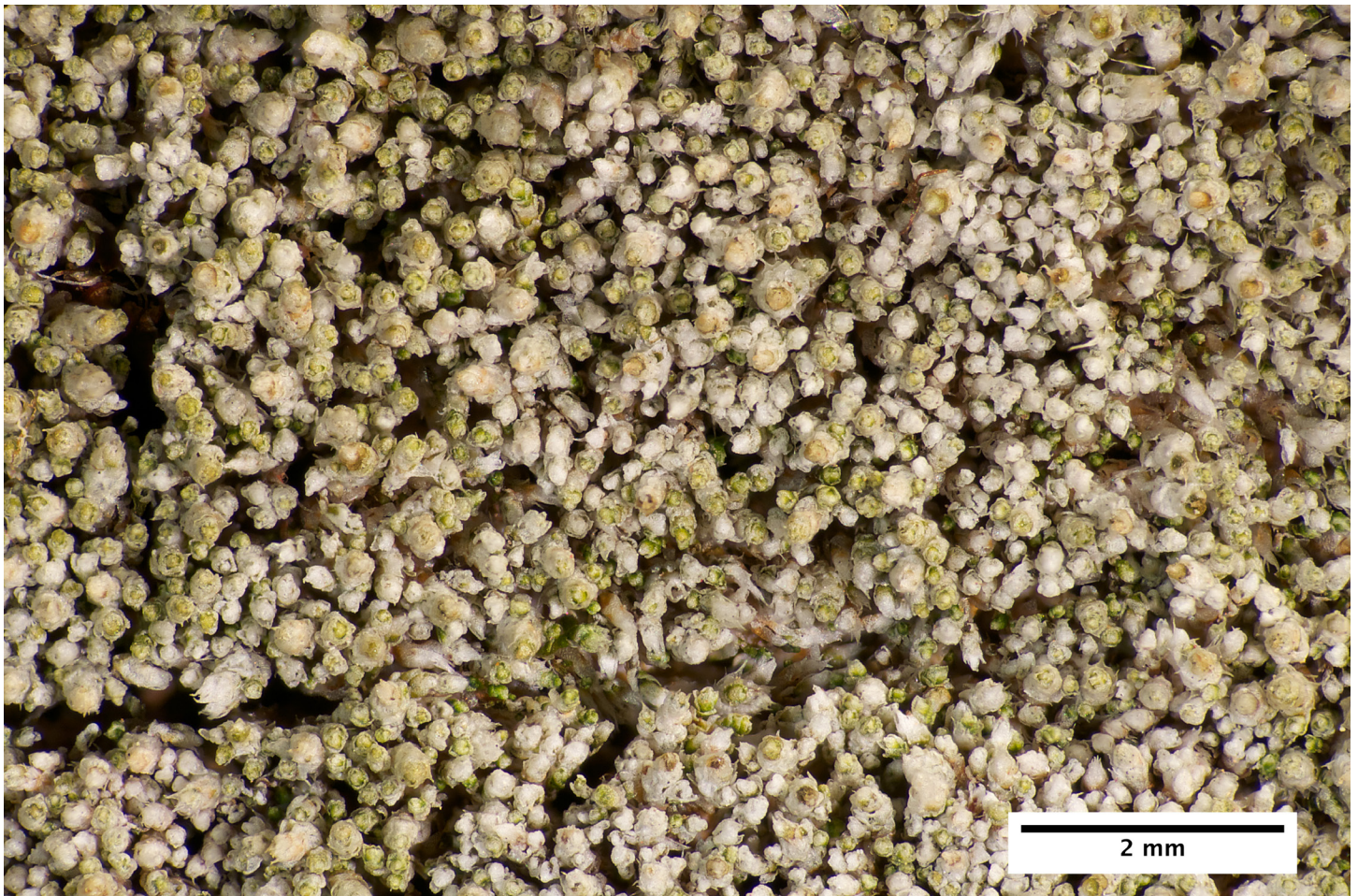


Figure 137. Habit, dry (Brinda, 1645)

Bryum lanatum (P. Beauv.) Brid.

Distribution: probably cosmopolitan (but still unclear due to confusion with *B. argenteum*)

Habitat: soil, soil over rock, or rock crevices in arid regions

Distinctive Characters: whitish or silvery appearance due to hyaline upper lamina; leaves with costa excurrent in a stout awn that is $\pm$ recurved when dry

Similar Species: Other Bryaceae species from exposed sites that have chlorotic apices are regularly misidentified as *Bryum argenteum* s.lat.; these can usually be distinguished by their more yellowish coloration, especially in species with stout awns.

Illustrations: figure 138, Spence & Ramsay (2002, as *Anomobryum lanatum*)



Figure 138. Habit, dry (Brinda, 1898)

Gemmabryum violaceum (Crundw. & Nyholm) J.R. Spence

Distribution: probably widespread but incompletely known

Habitat: on soil, usually in disturbed areas

Distinctive Characters: weedy plants with small, red-purple to orange tubers contrasting with violet rhizoids

Similar Species: *Gemmabryum valparaisense* is similar but both the rhizoids and tubers are brownish.

Illustrations: figures 139-140, Zolotov (2000)



Figure 139. Rhizoidal tuber (Brinda, 1899)

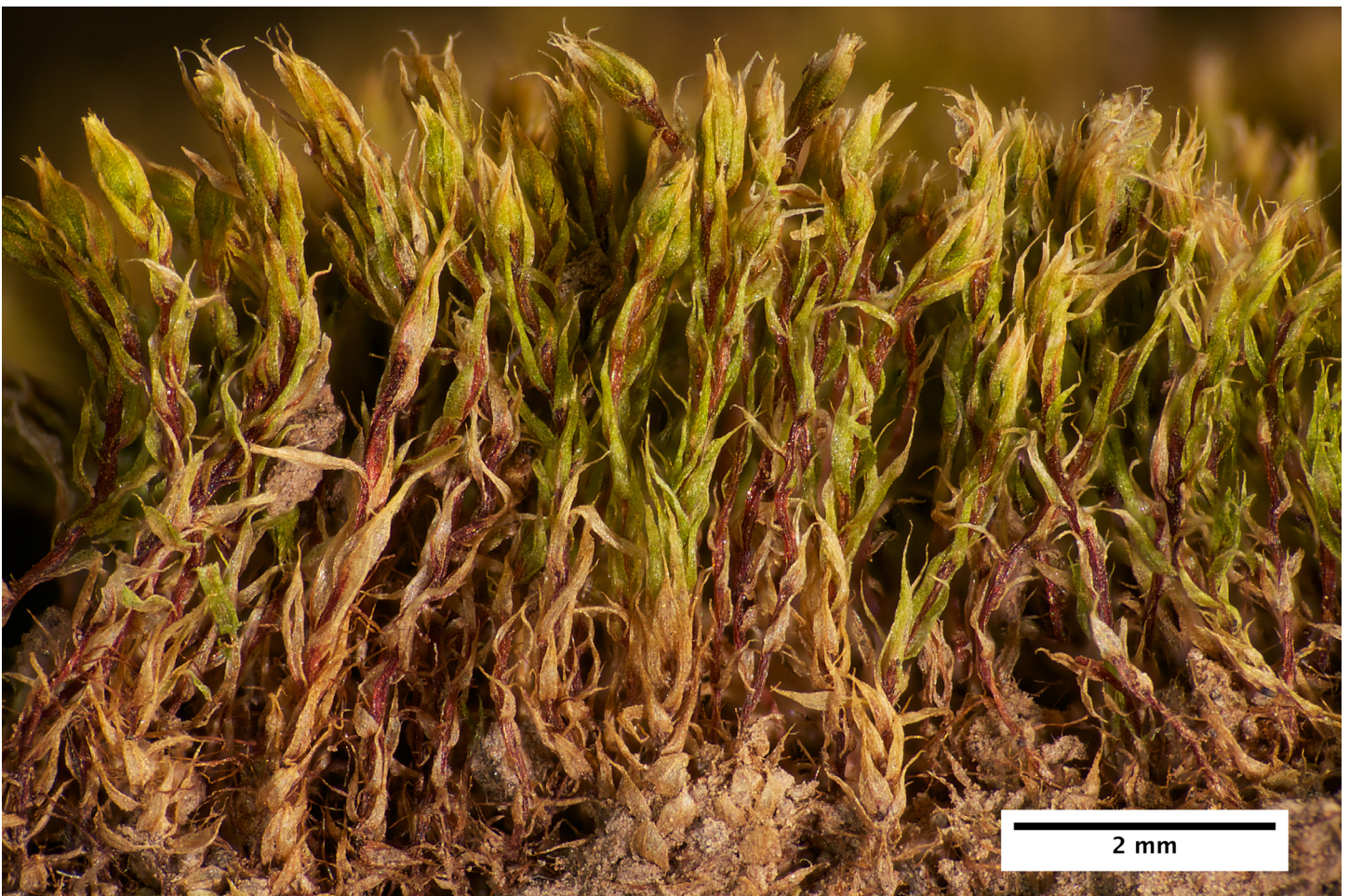


Figure 140. Habit, dry (Brinda, 1899)

Gemmabryum kunzei (Hornsch.) J.R. Spence

Distribution: probably widespread but incompletely known

Habitat: on exposed to shaded soil

Distinctive Characters: small plants forming dense yellow-green turfs on exposed soil; leaves imbricate with a stout, straight awn

Similar Species: *Gemmabryum caespitium* is usually larger and has elongate median-distal laminal cells, to 4:1 or more (vs. 2-3:1 in *G. kunzei*).

Illustrations: figure 141, Zolotov (2000)



Figure 141. Habit, dry (Brinda, 1596)

Gemmabryum dichotomum (Hedw.) J.R. Spence & H.P. Ramsay

Distribution: sub-cosmopolitan

Habitat: on soil, usually in disturbed areas

Distinctive Characters: small plants forming loose yellow-green turfs on exposed soil; large bulbils borne singly in the leaf axils

Similar Species: *Gemmabryum kunzei* is similar but has more prominent awns and lacks bulbils.

Illustrations: figure 142, Zolotov (2000)



Figure 142. Habit, dry (Brinda, 1697)

Orthotrichum laevigatum fo. *macounii* (Austin) E. Lawton & Vitt

Distribution: western North America (other forms also in Europe and Asia)

Habitat: acidic rock in coniferous forests

Distinctive Characters: robust plants with exserted, smooth, cylindrical capsules; basal cells elongate and nodulose

Similar Species: The typical form of *O. laevigatum* has more obtuse leaves and lower papillae.

Illustrations: figure 143, Flowers (1973, as *O. macounii*)



Figure 143. Habit, dry (Brinda, 1612)

Orthotrichum rupestre Schleich. ex Schwägr.

Distribution: sub-cosmopolitan

Habitat: acidic rock in coniferous forests

Distinctive Characters: robust plants with immersed to emergent, smooth, oblong capsules; basal cells elongate and nodulose

Similar Species: Plants from our area belong to the form recognized by some authors as *O. texanum* that differs from the typical form in peristome ornamentation.

Illustrations: figure 144, Flowers (1973, as *O. texanum*)



Figure 144. Habit, dry (Brinda, 1755)

Orthotrichum diaphanum Schrad. ex Brid.

Distribution: widespread in the northern hemisphere

Habitat: here restricted to the trunks of oak trees

Distinctive Characters: small epiphytic plants with short hyaline awns; septate gemmae usually abundant

Similar Species: *Orthotrichum pumilum* is similar but lacks the hyaline awn.

Illustrations: figures 145-147, Vitt (1994)



Figure 145. Habit, dry (Brinda, 1922)



Figure 146. Habit, dry (Brinda, 1922)



Figure 147. Leaf (Brinda, 1922)

Orthotrichum pumilum Sw.

Distribution: widespread in the northern hemisphere

Habitat: here restricted to the trunks of oak trees

Distinctive Characters: small epiphytic plants; septate gemmae usually abundant

Similar Species: *Orthotrichum pallens* is similar but has more exposed stomata and smaller leaf cells.

Illustrations: figure 148, Lewinsky-Haapasaari (1995)



Figure 148. Habit, dry (Brinda, 1891)

Orthotrichum anomalum Hedw.

Distribution: widespread in the northern hemisphere

Habitat: dry rock (here commonly on basalt)

Distinctive Characters: exserted ribbed capsules; leaf lamina unistratose

Similar Species: In *O. hallii* the capsules are immersed and the leaves commonly bistratose.

Illustrations: figure 149, Vitt (2009)

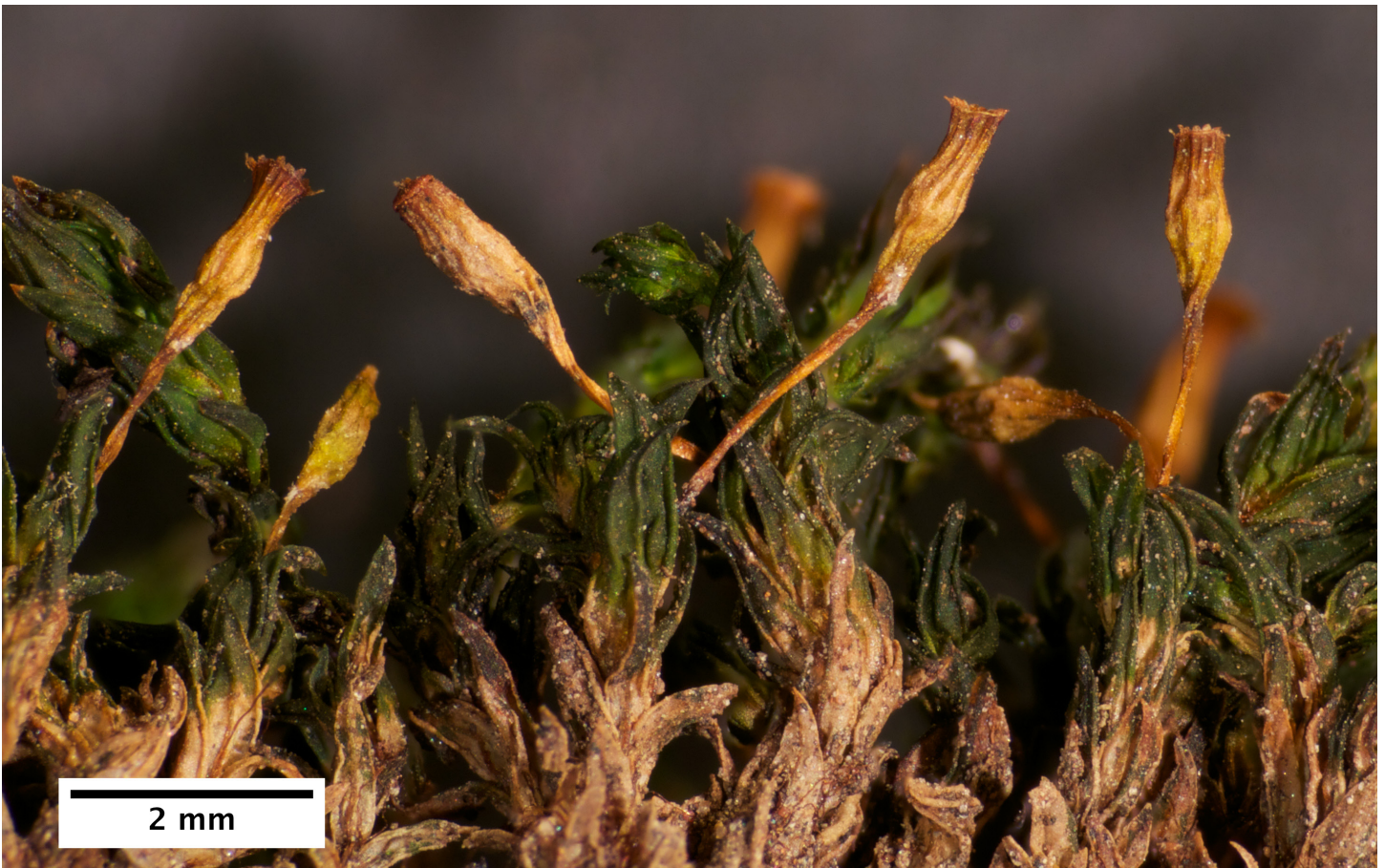


Figure 149. Habit, dry (Brinda, 1837)

Orthotrichum cupulatum Hoffm. ex Brid.

Distribution: widespread in the northern hemisphere

Habitat: dry rock

Distinctive Characters: cup-like capsules with 16 ribs; tall papillae giving the leaves a frosted appearance; acute leaf apices

Similar Species: *Orthotrichum pellucidum* also has tall papillae but the capsules have 8 ribs and the leaf apices are more obtuse.

Illustrations: figure 150, Vitt (2009)



Figure 150. Habit, dry (Brinda, 1647)

Orthotrichum hallii Sull. & Lesq.

Distribution: western North America (possibly also in central Asia)

Habitat: dry rock

Distinctive Characters: capsules with 8 ribs; papillae low and conical; lamina usually distinctly bistratose

Similar Species: The capsules of *O. cupulatum* have 16 ribs and the leaves are more strongly papillose.

Illustrations: figures 151-152, Flowers (1973)

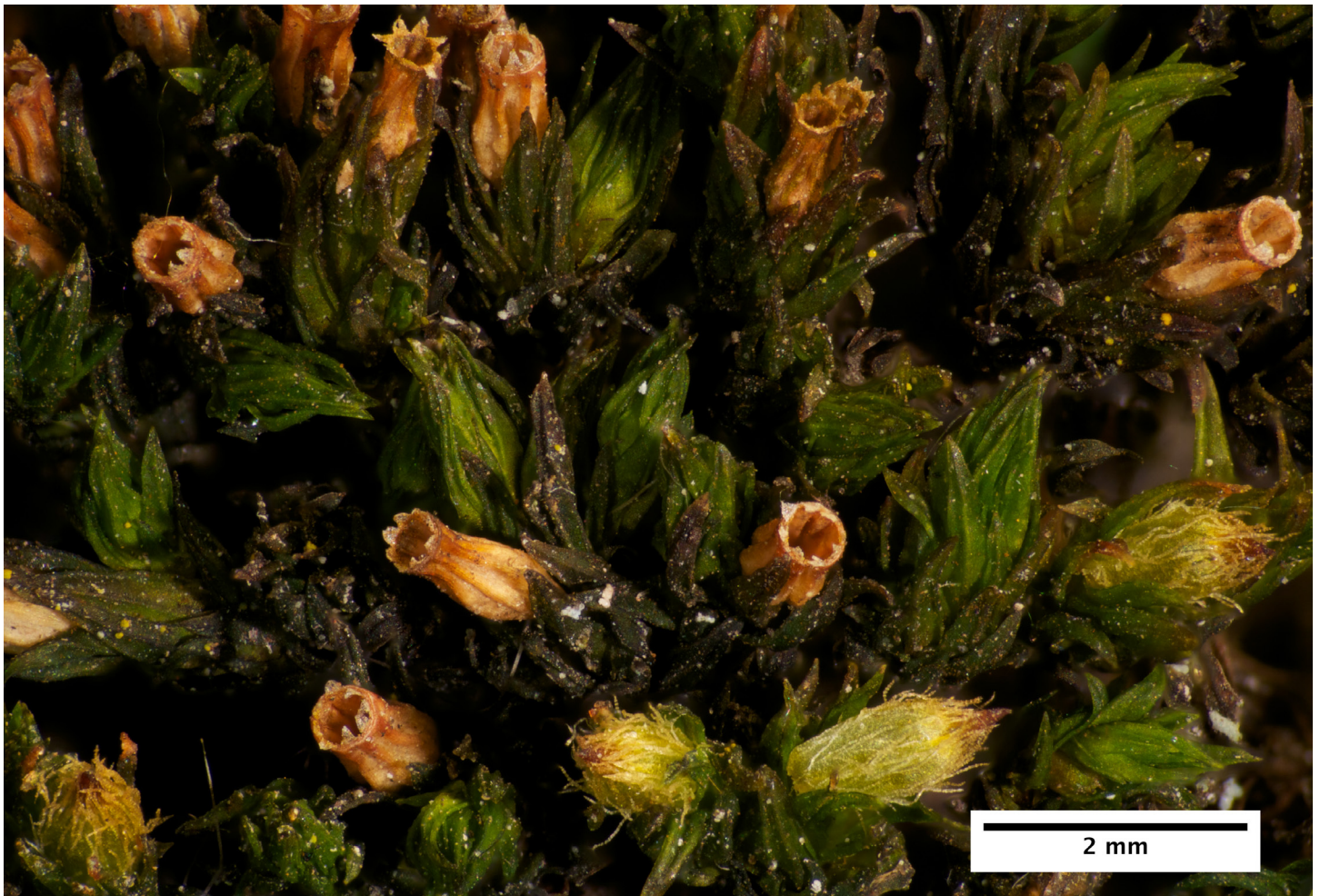


Figure 151. Habit, dry (Brinda, 1822)



Figure 152. Leaf (Brinda, 1822)

Claopodium whippleanum (Sull.) Renauld & Cardot

Distribution: western North America, Hawaii, Europe

Habitat: soil or soil over rock (here found as isolated stems intermixed with other mosses)

Distinctive Characters: bordered, toothed leaves with a single large papillum per cell

Similar Species: *Claopodium crispifolium* is similar but in that species the leaves have hairpoints.

Illustrations: figures 153-155, Harpel (2010)



Figure 153. Habit, dry (Brinda, 1769b)

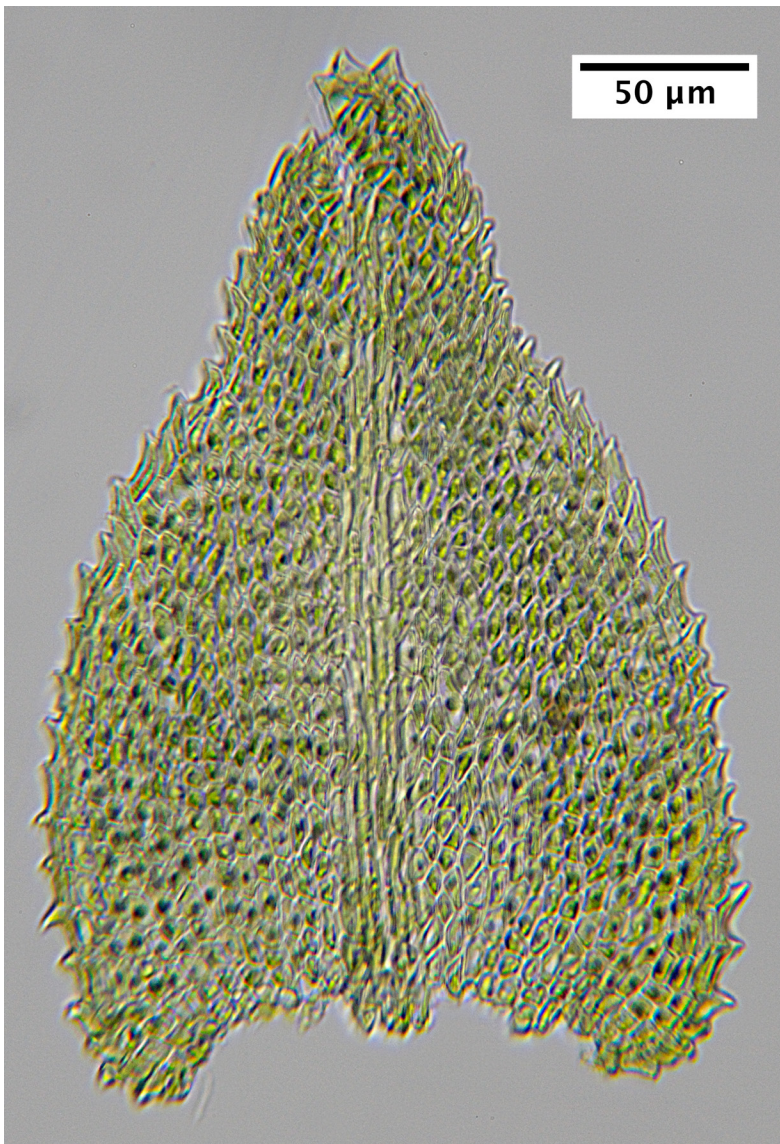


Figure 154. Leaf (Brinda, 1769b)

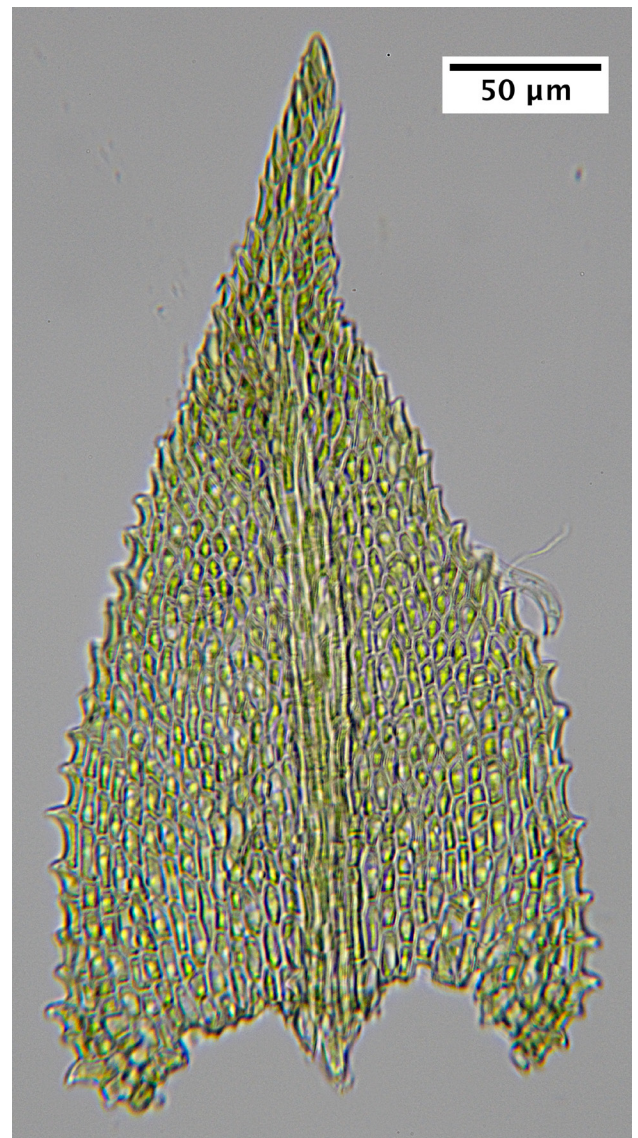


Figure 155. Leaf (Brinda, 1769b)

Conardia compacta (Müll. Hal.) H. Rob.

Distribution: widespread in the northern hemisphere

Habitat: calcareous springs, wet cliffs, and the bases of trees

Distinctive Characters: small pleurocarpous moss with warty-papillose, much branched rhizoids that are frequently inserted on the back of the costa or near the leaf apex (figures 157-158)

Similar Species: *Amblystegium* species are similar though probably not closely related; their rhizoids are smooth and never appear on the surface of the leaf.

Illustrations: figures 156-158, Hedenäs (2003)

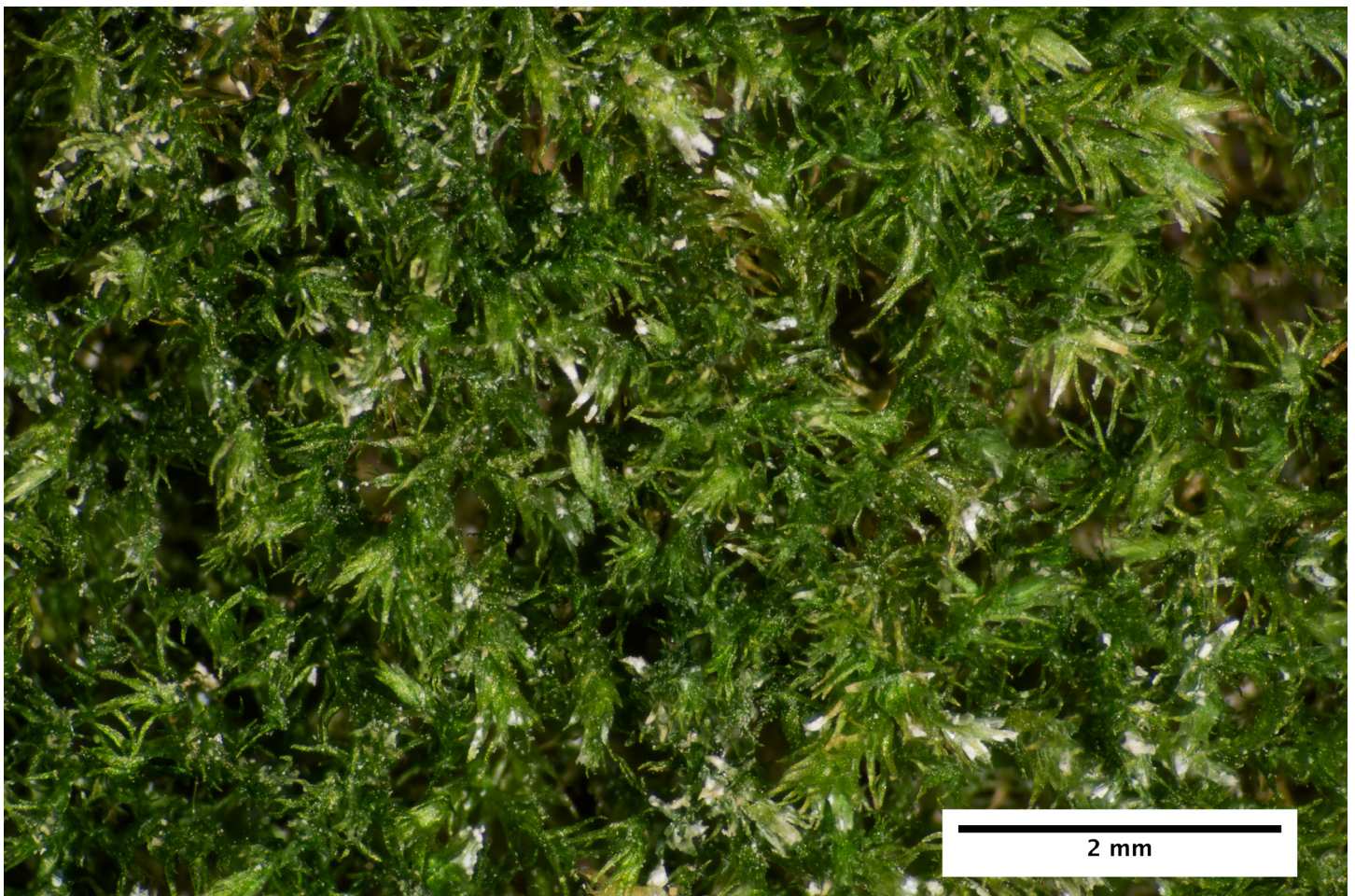


Figure 156. Habit, dry (Brinda, 1630)

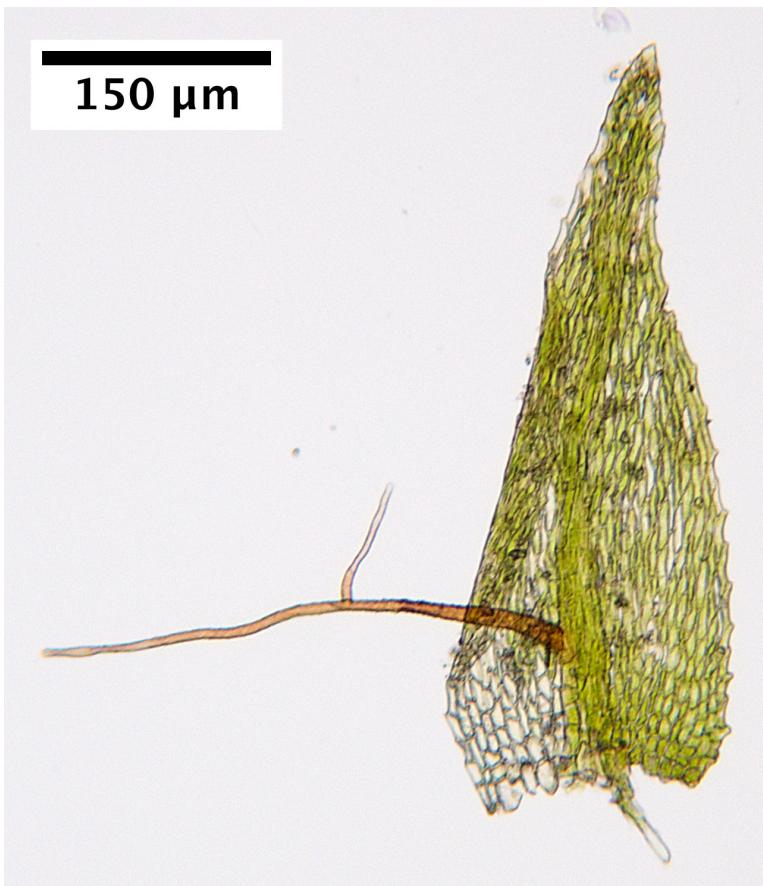


Figure 157. Leaf (Brinda, 1630)



Figure 158. Leaf (Brinda, 1630)

Homalothecium nevadense (Lesq.) Renauld & Cardot subsp. *nevadense*

Distribution: western North America

Habitat: on rocks and soil (here found on basalt)

Distinctive Characters: large golden-yellow plants with imbricate leaves and stems curved when dry

Similar Species: The closely related *Homalothecium aeneum* has a curved capsule with well-developed cilia and a larger, less obscure alar region.

Illustrations: figure 159, Hofmann (1998)

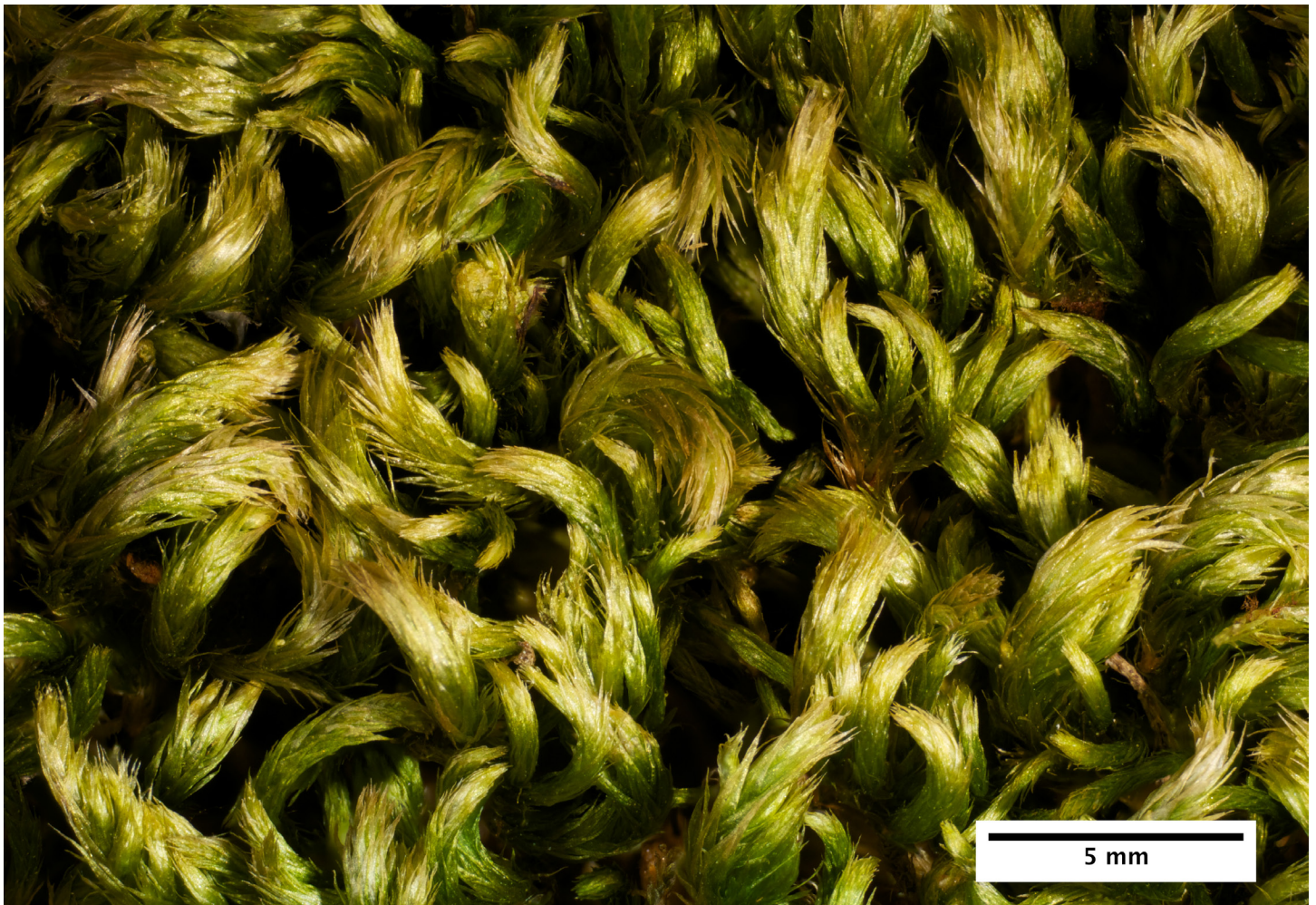


Figure 159. Habit, dry (Brinda, 1766)

Eurhynchiastrum pulchellum (Hedw.) Ignatov & Huttunen var. *pulchellum*

Distribution: widespread in the northern hemisphere

Habitat: soil, rock, decaying wood, and tree bases

Distinctive Characters: broadly triangular leaves and blunt apices with cells shorter than the adjacent lamina

Similar Species: The other species of Brachytheciaceae found in our area have more acute apices.

Illustrations: figure 160, Ignatov (2009)



Figure 160. Habit, dry (Newberry, s.n.)

Brachytheciastrum collinum (Schleich. ex Müll. Hal.) Ignatov & Huttunen

Distribution: widespread in the northern hemisphere

Habitat: on shaded soil or thin soil over rock

Distinctive Characters: pleurocarpous plants that are autoicous, with curved capsules and well-developed cilia; leaves somewhat concave and abruptly acuminate with a well-defined alar region

Similar Species: *Brachytheciastrum fendleri* has narrower leaves, is synoicous and has erect capsules with reduced cilia.

Illustrations: figures 161-162, Flowers (1973)



Figure 161. Sporophyte (Brinda, 1785)

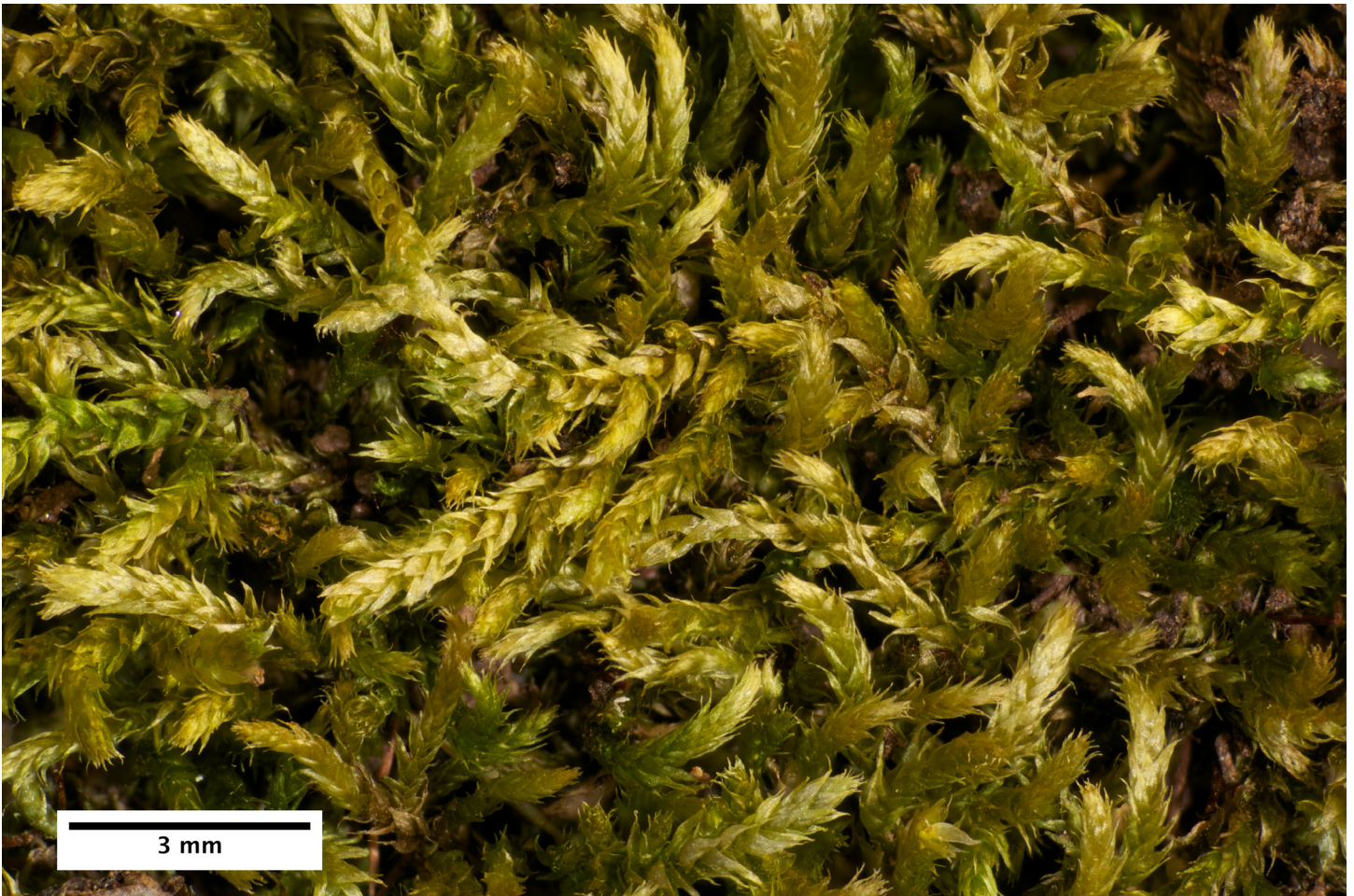


Figure 162. Habit, dry (Brinda, 1785)

Brachytheciastrum fendleri (Sull.) Ochyra & Żarnowiec

Distribution: western North America, Europe (but probably more widespread)

Habitat: on soil and thin soil over rock

Distinctive Characters: pleurocarpous plants that are synoicous with erect capsules and reduced cilia

Similar Species: *Brachytheciastrum olympicum* has a similar leaf shape but with a less well-defined alar region and is autoicous with curved capsules and well-developed cilia.

Illustrations: figure 163, Flowers (1973)



Figure 163. Dry habit, showing the erect capsules (Brinda, 1848)

Brachytheciastrum olympicum (Jur.) Vanderpoorten, Ignatov, Huttunen & Goffinet

Distribution: probably widespread in the northern hemisphere

Habitat: soil, soil over rock, and the bases of trees

Distinctive Characters: pleurocarpous plants that are autoicous with curved capsules and well-developed cilia; leaves gradually acuminate with a poorly-defined alar region

Similar Species: *Brachytheciastrum velutinum* is similar but has somewhat falcate leaves and setae that are rough throughout their entire length.

Illustrations: figure 164, Lawton (1971, as *Brachythecium venustum*), Flowers (1973, as *Brachythecium suberythrorrhizon*)

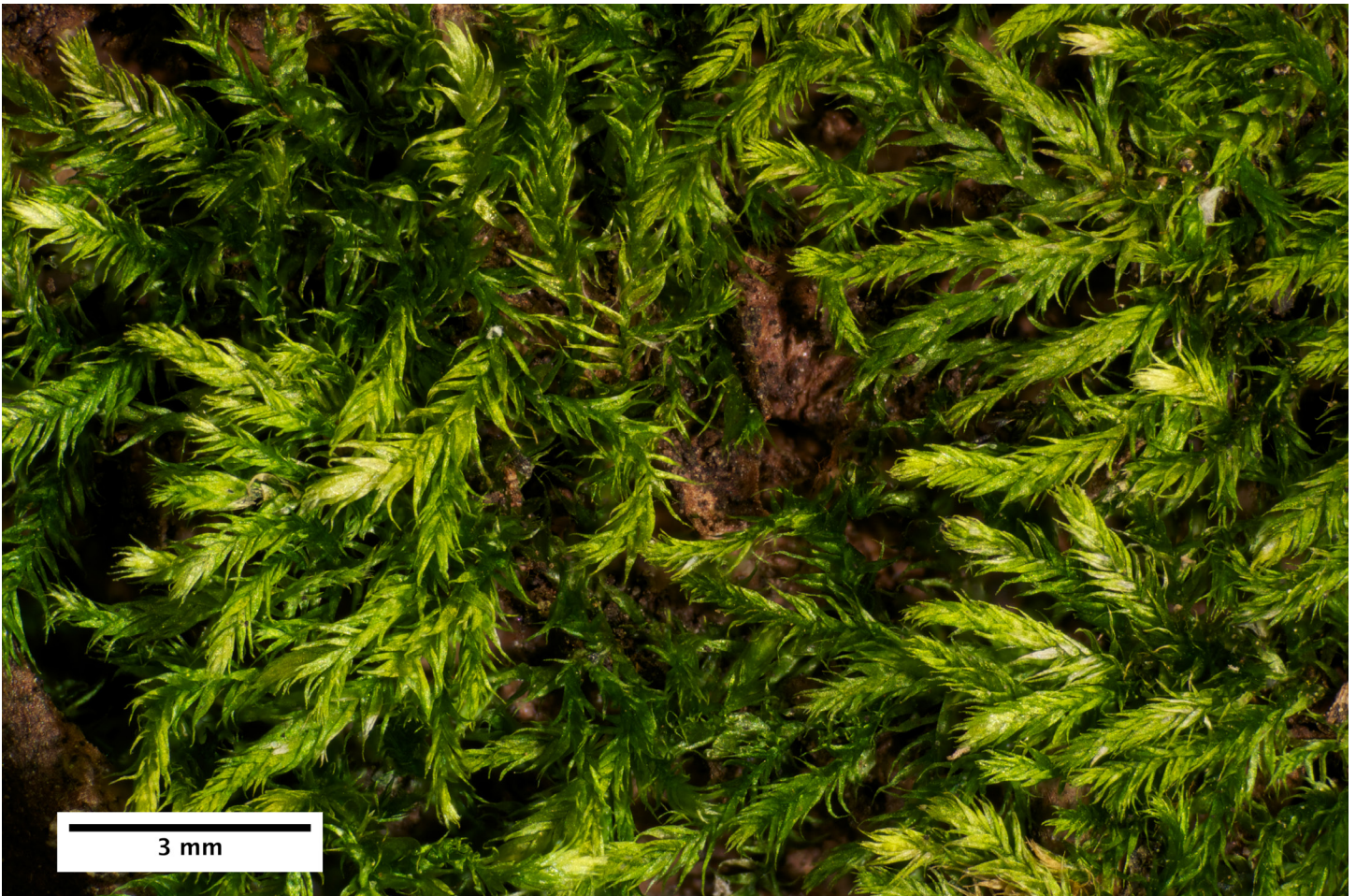


Figure 164. Habit, dry (Brinda, 1772)

Isothecium obtusatum Kindb.

Distribution: western North America

Habitat: dry rock and fallen logs

Distinctive Characters: pleurocarpous plants with creeping stems and leaves with acute, toothed apices; distal ends of some laminal cells projecting as spines

Similar Species: *Isothecium stoloniferum* is similar but the leaves are larger and more acuminate.

Illustrations: figures 165-166, Allen & Whittemore (1996)



Figure 165. Habit, dry (Brinda, 1784)



Figure 166. Leaf (Brinda, 1784)

Neckera pennata Hedw.

Distribution: sub-cosmopolitan

Habitat: shaded rock and the bases of trees

Distinctive Characters: pleurocarpous plants with complanate, undulate leaves; costa short, double or lacking

Similar Species: *Neckera menziesii* is similar but has a strong, single costa for 3/4 of the leaf length.

Illustrations: figure 167, Crum & Anderson (1981)



Figure 167. Habit, dry (Brinda, 1888)

Stereodon vaucheri (Lesq.) Lindb. ex Broth.

Distribution: widespread in the northern hemisphere, South America

Habitat: calcareous rock, soil, and tree bases

Distinctive Characters: pleurocarpous plants, often pinnately branched with leaves sometimes falcate secund; leaf margins plane throughout; alar region of small, thick-walled cells

Similar Species: *Hypnum cupressiforme* is similar but its leaves are more gradually acuminate with more elongate cells.

Illustrations: figure 168, Flowers (1973, as *Hypnum vaucheri*)



Figure 168. Habit, dry (Brinda, 2078)

Stereodon revolutus Mitt.

Distribution: sub-cosmopolitan

Habitat: rock, soil, and tree bases

Distinctive Characters: pleurocarpous plants, often pinnately branched with leaves $\pm$ falcate secund; leaf margins revolute their entire length; alar region of small, thick-walled cells

Similar Species: *Stereodon vaucheri* is similar but lacks the revolute leaf margins and its alar cells are more numerous.

Illustrations: figure 169, Flowers (1973, as *Hypnum revolutum*)



Figure 169. Habit, dry (Brinda, 1886)

Pseudoleskeella tectorum (Funck ex Brid.) Kindb. ex Broth.

Distribution: widespread in the northern hemisphere

Habitat: rock or tree bases

Distinctive Characters: thin mats of tiny, dark green plants; the costa is usually weak but variable and sometimes completely absent

Similar Species: *Homomallium mexicanum* is larger and the leaves have more elongate cells.

Illustrations: figure 170, Wilson & Norris (1989)

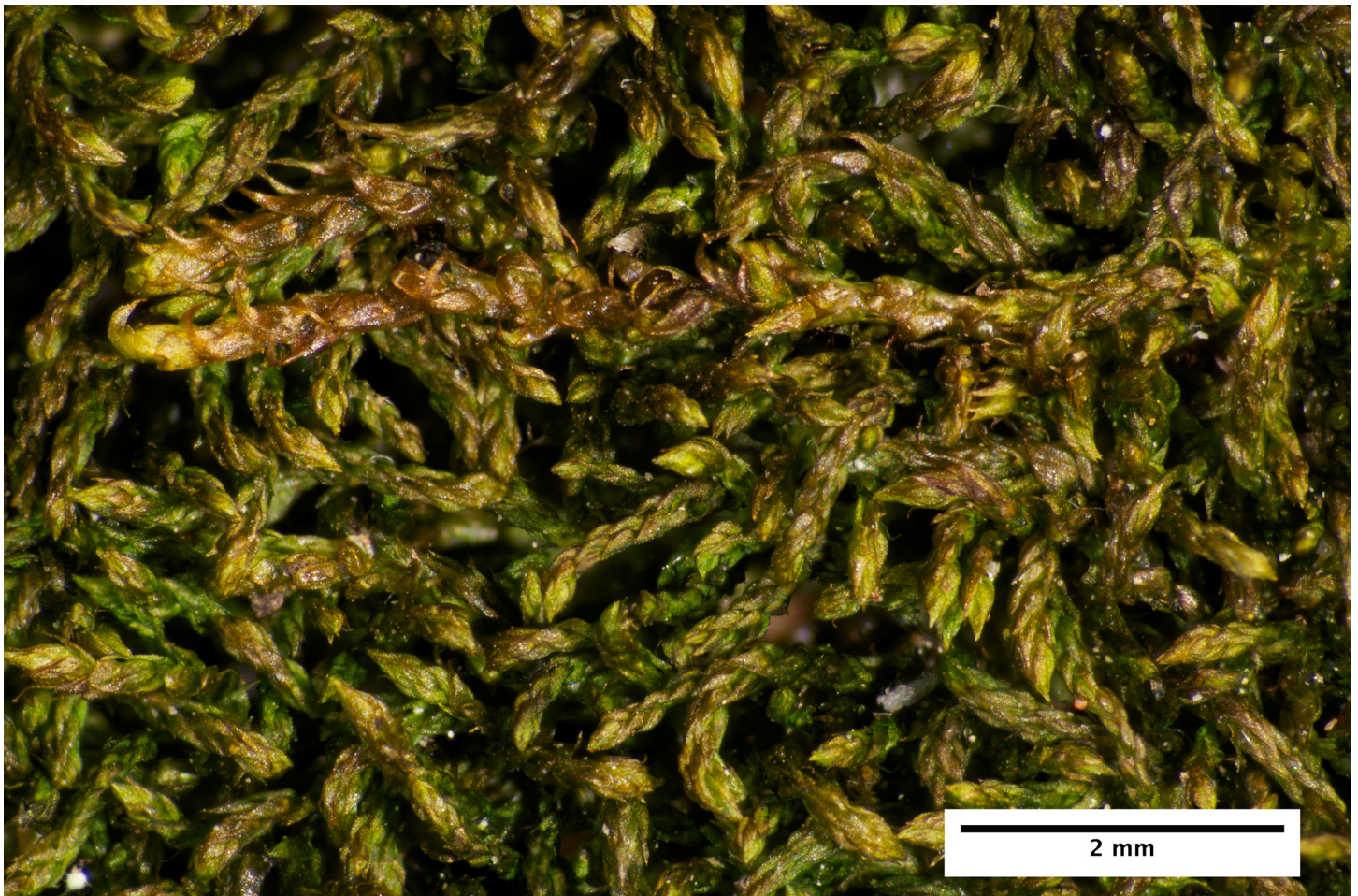


Figure 170. Habit, dry (Brinda, 1845)

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