

## 12. FUNARIACEAE Schwägrichen

Terry T. McIntosh

Plants minute to medium-sized, gregarious to forming open tufts, light- to yellow-green, annual to biennial. **Stems** short, erect, simple or with a few branches, central strand present, basal rhizoids few. **Leaves** usually larger and more crowded distally, often comose, reduced proximally, usually contorted when dry, spreading when wet, broadly elliptic to obovate, usually concave, margins plane to somewhat incurved, entire to serrate, sometimes limbate, apex acute to acuminate, rarely somewhat blunt, costa single, percurrent to excurrent; distal and median cells usually irregular-rhombic to hexagonal or rectangular, smooth and rather thin-walled, often lax, weakly chlorophyllose, proximal cells usually longer, oblong to rectangular, sometimes weakly inflated at proximal angles, differentiated alar cells absent. **Specialized asexual reproduction** absent. **Sexual condition** autoicous, sometimes polygamous, rarely synoicous or paroicous. **Perigonia** terminal on short basal branches, bud-like, paraphyses yellowish and club-shaped. **Perichaetia** terminal, paraphyses usually absent and filiform when present, perichaetial leaves often somewhat enlarged. **Seta** terminal, solitary, short to elongate, erect to somewhat curved, smooth or rarely papillose. **Capsule** stegocarpous or cleistocarpous, immersed to exserted, globose or pyriform to cupulate, sometimes flaring, symmetric and nearly smooth to asymmetric and striate when dry, usually with a neck; exothecial cells thick- to thin-walled; stomata restricted to neck, consisting of a slit in a rounded guard cell, superficial or immersed, annulus present or absent, revoluble, revoluble in fragments, or not; operculum present or absent, flat, conic-rounded, to rostrate; peristome double, single, rudimentary, or absent, exostome teeth 16, erect to incurved, papillose-striolate or striate, trabeculate on adaxial surface, endostome segments 16 and opposite the exostome teeth, cilia absent, represented only by the exostome when single. **Calyptra** deciduous or persistent, mitrate to cucullate, smooth, usually long-rostrate and inflated towards the base. **Spores** spherical or sub-reniform, strongly ornamented to smooth.

Genera ca. 13, species ca. 300 (6 genera, 29 species in the flora): worldwide except Antarctica.

The Funariaceae is characterized by broad leaves, large, pale laminal cells, opposite peristomes, and the distinctive stomata. The majority of species are found in disturbed or open sites on bare soil. Many of the species are annuals or biennials, and some may be perennials. When sterile, only a few species have distinctive vegetative features that allow positive identification to genus or species level. Fortunately most are usually fertile and sporophytes are common, although seasonal.

SELECTED REFERENCES Crum, H. A. and L. E. Anderson. 1955. Taxonomic studies in the Funariaceae. *Bryologist* 58: 1–15.  
 Fife, A. J. 1985. A generic revision of the Funariaceae (Bryophyta: Musci). Part 1. *J. Hattori Bot. Lab.* 58: 149–196.

1. Calyptra large and four-angled, completely enclosing the mature capsule . . . . . 6. *Pyramidula*, p. 199
1. Calyptra smaller than mature capsule, not angled or persistent.
  2. Capsules immersed.
    3. Capsules rupturing irregularly; exothelial cells delicate, thin-walled . . . . . 4. *Physcomitrella*, p. 194
    3. Capsules operculate; exothelial cells firm, thick-walled or collenchymatous
      4. Exothelial cells collenchymatous; spores spiculose-papillose . . . . . 1. *Aphanorrhagma*, p. 181
      4. Exothelial cells not collenchymatous; spores papillose . . . . . 5. *Physcomitrium* (in part), p. 196
  2. Capsules emergent or long-exserted.
    5. Capsules inclined and asymmetric; peristome double, endostome well developed to somewhat rudimentary . . . . . 3. *Funaria*, p. 188
    5. Capsules erect and more or less symmetric; peristome either single, rudimentary, or absent.
      6. Capsules sub-cylindric to narrowly pyriform; most exothelial cells oblong to oblong-linear, rarely isodiametric; calyptra cucullate . . . . . 2. *Entosthodon*, p. 182
      6. Capsules urn-shaped, broadly pyriform, to cupulate; operculum rostrate; most exothelial cells irregularly hexagonal, ± isodiametric; calyptra mitrate to irregularly mitrate, sometimes appearing cucullate . . . . . 5. *Physcomitrium* (in part), p. 196

1. APHANORRHEGMA Sullivant in A. Gray, Manual, 647. 1848 • [Greek, *aphanes*, invisible, and *rhegma*, fracture, alluding to inconspicuous line of capsule dehiscence] [E]

Bernard Goffinet

**Plants** very small, scattered or gregarious. **Stems** to 5 mm, erect, branches simple or branching. **Leaves** crispate to contorted when dry, erect-spreading when moist, oblong-lanceolate, 2–2.5 mm; margins serrulate distally; apices short-acuminate; costa single, percurrent; proximal laminal cells rectangular, distal cells rectangular to almost quadrate. **Sexual condition** autoicous. **Seta** erect, to 0.2 mm. **Capsule** stegocarpous, erect, immersed, symmetric, globose, to 0.7 mm, smooth; exothelial cells collenchymatous, particularly those adjacent to line of dehiscence; stomata at the very base of the capsule, superficial; annulus narrow, consisting of 1(–2) rows of delicate, small cells; operculum conical, short-apiculate, line of dehiscence equatorial, peristome absent. **Calyptra** mitrate, 4–6 lobed, small, smooth. **Spores** spherical, spiny-papillose.

Species 1: e North America.

1. *Aphanorrhagma serratum* (Wilson & Hooker)  
 Sullivant in A. Gray, Manual, 647. 1848 [E] [F]



*Schistidium serratum* Wilson & Hooker, *Musc. Amer. S. States* 2: no. 20. 1841

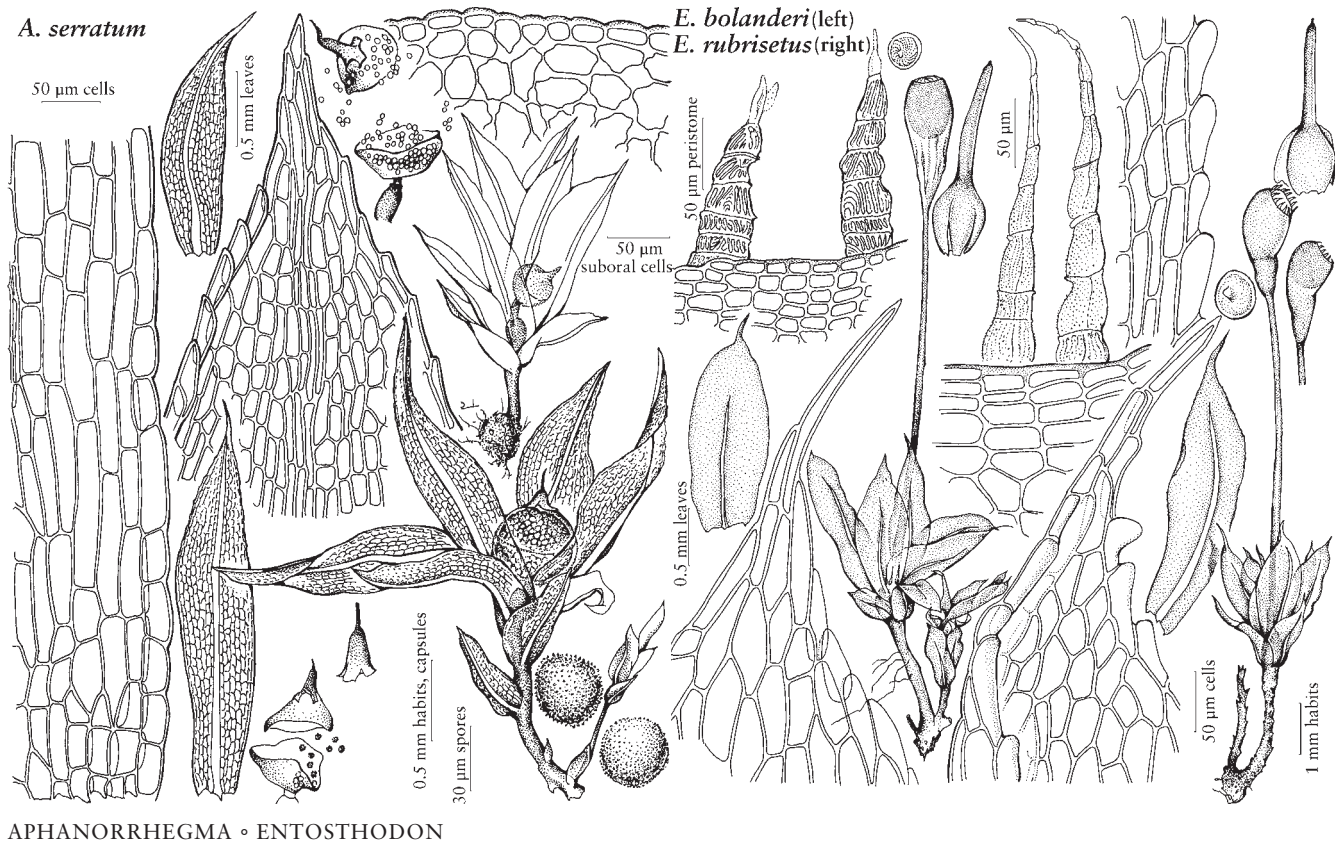
**Plants** gregarious to scattered; leaves slightly twisted when dry; perichaetial leaves erect-spreading when dry, exposing the capsule.

Capsules mature (Jul) Sep–Dec.

Soil, clay, along creeks or trails in places subject to inundation, rarely among other mosses; low to moderate elevations; Ont., Que.; Ark., Conn., D.C., Fla., Ill., Ind., Iowa, Kans., Ky., La., Md., Mich.,

Minn., Miss., Mo., Nebr., N.J., N.Y., N.C., Ohio, Okla., Pa., Tenn., Va., Vt., W.Va., Wis.

*Aphanorrhagma serratum* resembles the sympatric *Physcomitrella patens*, from which it differs in its capsule's regular line of dehiscence and collenchymatous exothelial cells; it also grows occasionally with *Physcomitrium immersum*. The latter two species are small and both have an immersed operculate capsule. *Physcomitrium immersum* is distinguished by a distal line of dehiscence (versus equatorial in *A. serratum*), the presence of an annulus of small cells, the thin-walled (versus collenchymatous) exothelial cells, and an urceolate rather than a globose operculate urn. *Aphanorrhagma serratum* has been reported from Texas by H. A. Crum and L. E. Anderson (1981). I have seen only one collection (DUKE)



APHANORRHAGMA • ENTOSTHODON

from that state, but the specimen lacks collenchymatous exothelial cells, bears a distinct annulus, and hence is here referred to *Physcomitrium immersum*.

2. ENTOSTHODON Schwägrichen, Sp. Musc. Frond. Suppl. 2(1,1): 44. 1823 • [Greek *entosthi*, within, and *odon*, tooth, alluding to position of teeth inside capsule]

Donna H. Miller

Harvey A. Miller

**Plants** small, tufted, green or yellowish. **Stems** short, erect, simple except for a reduced basal antheridial branch. **Leaves** larger distally, rosulate, crowded, erect-spreading, reduced in size proximally, oblong-ovate to obovate or spatulate, usually acute or acuminate, sometimes apiculate or piliferous, margins plane or erect, entire or serrulate beyond the middle, costa ending well before the apex to percurrent, distal and median cells mostly medium-sized, quadrate to hexagonal to oblong-hexagonal, rarely short-rhomboid, rather lax and thin-walled, sometimes linear at the margins forming a narrow border, proximal cells becoming oblong-rectangular, differentiated alar cells absent. **Sexual condition** autoicous or polygamous; antheridial branch basal, perigonial paraphyses clavate; perichaetia apparently absent paraphyses. **Seta** elongate, erect. **Capsule** exserted, erect or nearly so, narrowly pyriform to short-pyriform, symmetric, often smooth except at the neck when dry, annulus none, exothelial cells transverse, usually linear-oblong, incrassate with radial walls thicker toward the inner tangential wall than the

surface wall; stomata present and formed from single cell; peristome absent to well developed, single or double, inserted proximal to the mouth, teeth papillose-striate, weakly trabeculate to appendiculate or absent these features, segments of the endostome, often evanescent and not seen, rarely more than  $\frac{1}{4}$  the length of the teeth or absent; operculum nearly plane to conic-convex or domed, cells usually in obliquely radial rows. **Calyptra** large, long-rostrate, cucullate and inflated. **Spores** smooth or weakly papillose to tuberculate or bacculate-insulate.

Species ca. 20 (12 in the flora): North America, Mexico, Central America, South America, Europe, Asia, Africa, Pacific Islands.

*Entosthodon* as it is defined here is mainly associated with Mediterranean, shrub-steppe, or desert climates with pronounced wet and dry seasons. The genus is almost certainly undercollected in dry and seasonally dry tropical and warm temperate climates because of the relatively short growth season. *Entosthodon* is a vexing genus because most species: (1) are short lived; (2) are small and, for the most part, form small, inconspicuous tufts; (3) are usually collected with clinging substrate and careful cleaning is needed; and (4) are frequently in admixture with other small mosses. Fortunately, sporophytes are usually present; otherwise they would probably escape notice. Only *E. drummondii* is reasonably abundant in herbaria; the other species are represented in collections so uncommonly that their geographic range can only be estimated. It is possible that species are too narrowly drawn in this treatment, but insufficient evidence is available to justify recognizing fewer taxa. Edwin Bartram once remarked (pers. comm.) that he disliked describing new species; he felt defeat when he could not find a proper name but was obliged to provide one or else the taxon would go unrecognized. *Entosthodon* could have been one of the genera he was talking about.

1. Leaves broadly acute to rounded-obtuse; capsules short-pyriform, 1–1.4 mm, peristome well developed.
  2. Leaves to 2 mm, rounded-obtuse; peristome double, exostome vertically striate throughout and sometimes perforate, endostome a low irregular papillose membrane; spores rounded, 27–36  $\mu\text{m}$  . . . . . 1. *Entosthodon drummondii*
  2. Leaves about 1 mm, broadly acute, often short-apiculate; peristome single, teeth finely papillose throughout to weakly striate-papillose basally, not perforate; spores angled, 17–19  $\mu\text{m}$  . . . . . 2. *Entosthodon kochii*
1. Leaves acute to acuminate, capsules pyriform, 1.5 mm or more long, peristome well developed, rudimentary, or absent.
  3. Spores usually adherent in tetrads at maturity; peristome teeth bright red and often perforate basally, with endostome well developed from a pale basal membrane bearing irregular segments . . . . . 3. *Entosthodon wigginsii*
  3. Spores separate at maturity; peristome various but absent the combination of characteristics given above, sometimes rudimentary or absent.
    4. Peristome rudimentary or absent.
      5. Costa of distal leaves ending below the leaf tip; spores to 40  $\mu\text{m}$  . . . . . 10. *Entosthodon tucsonii*
      5. Costa of the distal leaves ending in or near the tip to excurrent; spores 24–35  $\mu\text{m}$ .
        6. Medial exothecial cells oblong; marginal laminal cells undifferentiated, alar regions not auriculate . . . . . 11. *Entosthodon rubiginosus*
        6. Medial exothecial cells irregular to hexagonal, little longer than broad; marginal laminal cells longer and narrower than medial cells, alar regions sometimes forming auricles . . . . . 12. *Entosthodon fascicularis*
  4. Peristome well developed.
    7. Leaves bordered almost to the apex by at least two rows of often orangish, narrow cells . . . . . 4. *Entosthodon attenuatus*
    7. Leaves not bordered by rows of orangish, narrow cells.

[8. Shifted to left margin.—Ed.]

8. Leaves entire or nearly so.
9. Leaves with an acute tip that lacks a single long terminal cell, costa strong and ending just before the apex . . . . . 5. *Entosthodon californicus*
9. Leaves with an acuminate tip usually terminated by a single long cell, costa weak, reaching only  $\frac{1}{2}$ – $\frac{3}{4}$  the leaf length . . . . . 7. *Entosthodon bolanderi*
8. Leaves with distinctly serrate or serrulate margins distally.
10. Distal leaves acute to short-acuminate, marginal cells somewhat inflated . . . . . 6. *Entosthodon sonora*
10. Distal leaves filiform-acuminate or distinctly apiculate with a hair point, marginal cells not differentiated.
11. Operculum planoconvex; leaf apiculus about 250  $\mu$ m; capsule ovoid-pyriform, yellowish to brownish . . . . . 8. *Entosthodon planoconvexus*
11. Operculum conic-convex; leaf apiculus about 425  $\mu$ m; capsule claviform, deep brownish red . . . . . 9. *Entosthodon rubrisetus*

1. *Entosthodon drummondii* Sullivant, Musc. Hepat. U.S., 156b. 1856 [E]



*Entosthodon drummondii* var. *obtusifolius* Holzinger; *Funaria drummondii* (Sullivant) Lindberg

**Plants** 1–5 mm, yellowish to brownish green. **Leaves** curved inward when dry, oblong ovate to obovate, somewhat concave, imbricate, mostly 1.5–2 mm; margins faintly serrulate to entire;

apices broadly acute; costa percurrent or ending 1–3 cells before the apex; basal laminal cells rectangular (70–90  $\times$  25–35  $\mu$ m), distal cells oblong-hexagonal, marginal cells longer, often forming a yellowish border. **Seta** 10–20 mm, straight, not hygroscopic. **Capsule** ovoid-pyriform from a short apophysis, 1–1.4 mm, contracting when dry and empty; exothecial cells thickened, narrowly oblong and transversely elongate in 5–7 rows proximal to the mouth; operculum nearly flat, becoming convex when moistened; peristome double, exostome teeth brown, lanceolate, vertically striate throughout and sometimes perforate along the median line, endostome a low papillose membrane. **Calyptra** cucullate, long-beaked, inflated around the capsule, large, smooth. **Spores** 27–36  $\mu$ m, weakly bacculate-insulate, some faintly ridged, yellow-brown.

Disturbed, closely packed, usually somewhat sandy, soils in damp places; low to moderate elevations; Ala., Calif., Fla., Ga., La., Miss., N.C., Ohio, S.C., Tenn., Tex.

2. *Entosthodon kochii* H. A. Crum & L. E. Anderson, Bryologist 58: 12, figs. 16–19. 1955 [E]



**Plants** 2–3 mm, yellowish. **Leaves** mostly variously contorted when dry, ovate to oblong or obovate, imbricate, somewhat concave, 0.5–1.2 mm; margins entire; apices broadly acute, often ending in a 1–2-celled apiculus; costa ending 4–7 cells before the tip; basal laminal cells rectangular,

distal cells hexagonal to oblong-hexagonal, not differentiated at the margins. **Seta** 3.5–7 mm. **Capsule** short pyriform with neck shorter than the spore sac, 1–1.4 mm; exothecial cells thickened, narrowly oblong and transversely elongate in 5–7 rows proximal to the mouth; operculum planoconvex; peristome single, teeth narrowly lanceolate, finely papillose, or weakly papillose-striate below. **Calyptra** not seen. **Spores** 17–19  $\mu$ m, finely papillose and angled.

River banks on newly exposed soil; moderate elevations; Calif.

The description above is derived from H. A. Crum and L. E. Anderson (1955), who remarked, “The most distinctive feature of *E[ntosthodon] kochii* is the teeth of the peristome which are well developed and similar to those of *E. bolanderi* or *E. sonora* (Cardot) Steere (= *E. bartramii* Grout) except that they are not or only faintly striate. The broadly acute leaves, small capsules, and smaller spores separate this species from *E. bolanderi* and *E. sonora*. Both frequently possess a rudimentary endostome. D. H. Norris and J. R. Shevock (2004) reported three additional county records for California.

3. *Entosthodon wigginsii* Steere, Bryologist 41: 36, figs. 1–8. 1938 [E]



Plants 2–5 mm, yellow green, the main axis often arising from a fleshy rhizome. Leaves shriveled and distorted when dry, obovate to oblong-spathulate, imbricate, somewhat concave, mostly 2–3 mm; margins serrulate by projecting ends of thin-walled cells; apices acute, sometimes with

a short apiculus; costa ending 4–6 cells before the apex; basal laminal cells rectangular (85–120 × 25–30 μm), distal cells irregularly polygonal to hexagonal or oblong-rectangular, a little longer but not otherwise differentiated at the margins. Seta brownish basally and paler distally, 5–8 mm, straight, not hygroscopic. Capsule pyriform to elongate-pyriform from an apophysis about half the total length, 1.5–2 mm, becoming sulcate when dry and empty; exothecial cells thickened, narrowly oblong and transversely elongate in 4–5 rows proximal to the mouth; operculum planoconvex; peristome double, exostome teeth bright red becoming paler at the tip, lanceolate with 7–8 articulations, obliquely striate basally, papillose at the tips, endostome well developed from a pale basal membrane bearing irregular segments. Calyptra cucullate, long-beaked, inflated around the capsule, large, smooth. Spores 20–24 μm, bacculate-insulate often in persistent tetrads at maturity.

Fine soil, crevices of rocks, base of cliffs; moderate to high elevations; Ariz., Utah.

4. *Entosthodon attenuatus* (Dickson) Bryhn, Kongel. Norske Vidensk. Selsk. Skr. (Trondheim) 1908(8): 25. 1908



*Bryum attenuatum* Dickson, Plantae Cryptogam., fasc. 4: 8, plate 19, fig. 8. 1801; *Entosthodon templetonii* (Smith) Schwägrichen; *Funaria attenuata* (Dickson) Lindberg; *F. templetonii* Smith

Plants 2–5 mm, pale brownish yellow. Leaves variously contorted when dry, ovate to obovate or oblong-spathulate, imbricate, somewhat concave, mostly 2–3 mm long; margins crenulate-serrulate by inflated narrow thin-walled cells that often form a orangish border; apices narrowed to an acute tip terminating abruptly in a sharp, 1–2-celled apiculus; costa ending 3–5 cells before the tip; basal laminal cells rectangular (75–105 × 20–32 μm), distal cells irregularly hexagonal to oblong rectangular. Seta reddish, 6–10 mm, straight, not hygroscopic. Capsule elongate-pyriform from an apophysis about half the total length, 2–3 mm, somewhat sulcate when dry and empty; exothecial cells,

scarcely thickened, narrowly oblong and transversely elongate in 5–7 rows proximal to the mouth; operculum planoconvex, peristome well developed, exostome teeth reddish brown, lanceolate with 4–7 thin trabeculae, slender, fragile tips, striate basally and papillose at the tips, endostome not seen. Calyptra cucullate, long-beaked, inflated around the capsule, large, smooth. Spores 27–35 μm, smooth, often faintly angled.

Disturbed, seasonally wet, sandy soils along stream beds or roadside ditches; moderate to high elevations; Ariz., Calif., N.Mex., Tex.; Europe.

5. *Entosthodon californicus* (Sullivant & Lesquereux) H. A. Crum & L. E. Anderson, Bryologist 58: 13. 1955 [E]



*Funaria californica* Sullivant & Lesquereux, Musc. Bor.-Amer. ed. 2, 41. 1865

Plants 1–2 mm, dull yellow green. Leaves contorted and crispate when dry, oblong to oblong ovate, imbricate, concave, mostly about 1 mm; margins entire and not bordered; apices broadly acute to

rounded, often with a 1–2-celled apiculus; costa ending 4–6 cells before the tip; basal laminal cells rectangular (50–70 × 15–22 μm), distal cells nearly quadrate. Seta brownish yellow, 4–6 mm, not hygroscopic. Capsule ovoid-pyriform, the apophysis forming about half the length, 1.5–2 mm, somewhat sulcate when dry and empty; exothecial cells thickened, narrowly oblong and transversely elongate in 7–9 rows proximal to the mouth; operculum short convex-conic; peristome yellowish brown, lanceolate with trabeculae, papillose basally and nearly smooth at the tips; endostome segments shorter than the teeth, papillose. Calyptra cucullate, long-beaked, inflated around the capsule, large, smooth. Spores 15–18 μm, bacculate-insulate.

Along streams or roadsides on exposed fine sandy soil; moderate elevations; Calif., Oreg.

6. *Entosthodon sonorae* (Cardot) Steere, Bryologist 41: 39. 1938



*Funaria sonorae* Cardot, Rev. Bryol. 36: 110. 1909; *Entosthodon bartramii* Grout

Plants 2–4 mm, pale yellow green. Leaves variously contorted when dry, ovate to oblong to obovate, imbricate, somewhat concave, mostly 1.5–2 mm; margins serrulate by projecting ends of

thin-walled cells; apices acute, terminating in a 1–2-celled apiculus, costa ending 7–10 cells before the apiculus; basal

laminal cells rectangular (50–70 × 18–25 μm), distal cells irregularly short- to oblong-rectangular, somewhat inflated marginally. **Seta** pale yellow, 4–5 mm, straight, not hygroscopic. **Capsule** yellow, elongate-cylindrical from a neck half or more the total length, 2.5–3 mm, weakly sulcate when dry and empty; exothelial cells scarcely thickened, narrowly oblong (3–4:1) near the mouth and transversely elongate in 4–6 rows proximal to the mouth; operculum conic-rounded; peristome pale brownish yellow, lanceolate with thin trabeculae proximally and terminating in a 1–2-celled hyaline evanescent tip, striate basally and nearly smooth at the tips, endostome not seen. **Calyptra** cucullate, long-beaked, inflated around the capsule, large, smooth. **Spores** 18–25 μm, smooth.

Mineral soils, probably in shade of rocks or in crevices; moderate to high elevations; Ariz.; Mexico (Sonora).

*Entosthodon sonora* is restricted to the Sonoran Region of southwestern United States and northern Mexico.

7. *Entosthodon bolanderi* Lesquereux, Trans. Amer. Philos. Soc., n. s. 13: 10. 1865 [F]



*Funaria bolanderi* (Lesquereux)  
Holzinger

**Plants** 2–5 mm, pale yellow-green, the main axis often arising from a fleshy rhizome. **Leaves** variously contorted when dry, ovate to oblong or obovate, imbricate, somewhat concave, mostly 2–3 mm; margins entire to weakly

serrulate by projecting ends of thin-walled cells; apices narrowed to an acumen bearing a short, mostly 1-celled filiform tip; costa ending  $\frac{1}{2}$ – $\frac{3}{4}$  the leaf length; basal laminal cells rectangular (50–75 × 25–30 μm), distal cells irregularly rectangular, polygonal to oblong rectangular, little differentiated at the margins. **Seta** 6–10 mm, straight, not hygroscopic. **Capsule** ovoid-pyriform from an apophysis accounting for about half the total length, 2–3 mm, changing little when dry and empty; exothelial cells scarcely thickened, narrowly oblong and transversely elongate in 5–7 rows proximal to the mouth; operculum a rounded dome; peristome well developed, exostome teeth pale brownish yellow, lanceolate with thin trabeculae basally and terminating in a 1–2-celled hyaline evanescent tip, striate basally and nearly smooth at the tips, endostome not seen. **Calyptra** cucullate, long-beaked, inflated around the capsule, large, smooth. **Spores** 27–35 μm, weakly bacculate-insulate.

Mineral soils, probably alkaline, or rock crevices; moderate to high elevations; Ariz., Calif.; Mexico (Baja California).

In Baja California, *Entosthodon bolanderi* is found on Guadalupe Island.

8. *Entosthodon planoconvexus* (Bartram) Grout, Moss Fl. N. Amer. 2: 80. 1935 [E]



*Funaria planoconvexa* Bartram,  
Bryologist 31: 94, plate 9, figs. G–L.  
1928

**Plants** 2–7 mm, yellowish green, the main axis often arising from a short fleshy rhizome. **Leaves** variously contorted when dry, oblong to obovate or spatulate, imbricate, somewhat concave, mostly 2–3 mm; margins serrulate distally; apices acute, abruptly narrowing to a short filiform point about 250 μm in length; costa ending 5–9 cells before the apiculus; basal laminal cells rectangular (50–55 × 20–35 μm), distal cells irregularly quadrate to elongate-hexagonal to short-rectangular, little differentiated along the margins. **Seta** 6–10 mm, straight, twisted, hygroscopic. **Capsule** yellowish to brownish, ovoid-pyriform with about half the length in the apophysis, 2–3 mm, sulcate when dry and empty; exothelial cells scarcely thickened, narrowly oblong and transversely elongate in 5–7 rows proximal to the mouth; operculum planoconvex; peristome well developed, exostome teeth reddish brown to brownish yellow, lanceolate, striate papillose, trabeculate basally, terminating in a coarsely papillose tip, endostome evanescent with low, broad, segments. **Calyptra** cucullate, long-beaked, inflated around the capsule, large, smooth. **Spores** 20–25 μm, bacculate-insulate.

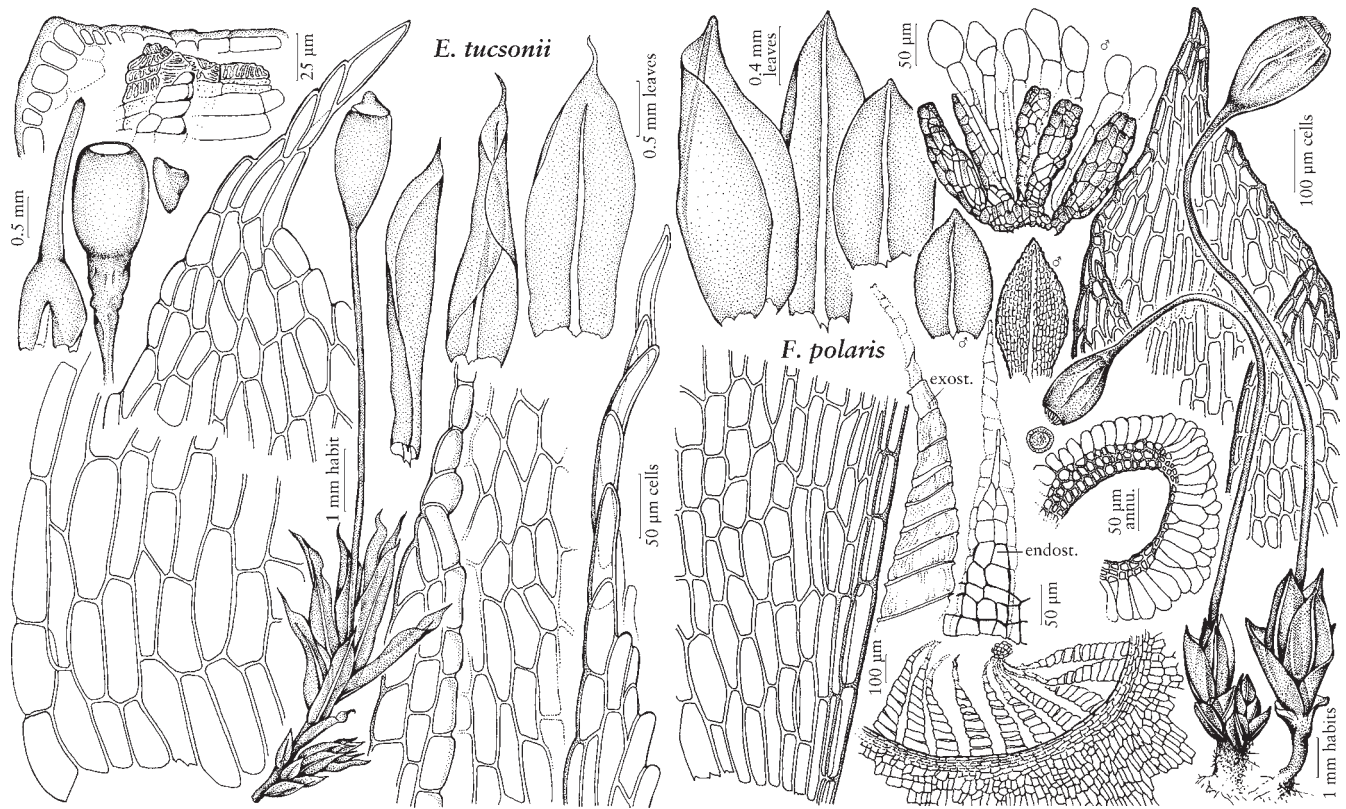
Sandy soil, canyons and desert washes; moderate to high elevations; Ariz., Calif., Utah.

9. *Entosthodon rubrissetus* (Bartram) Grout, Moss Fl. N. Amer. 2: 80. 1935 [E] [F]



*Funaria rubrisseta* Bartram,  
Bryologist 31: 93, plate 9, figs. A–F.  
1928

**Plants** 2–5 mm, pale yellow-green. **Leaves** little contorted when dry, ovate to obovate or spatulate, imbricate, concave, 2–3(–4) mm; margins serrulate distally by projecting ends of thin-walled marginal cells; apices gradually narrowed to a filiform acuminate tip about 425 μm; costa ending 5–8 cells before the acumen; basal laminal cells rectangular (40–55 × 20–25 μm), elongate near margins, distal cells quadrate to oblong polygonal, marginal cells not differentiated. **Seta** deep brownish red, 6–8 mm, straight, not or scarcely hygroscopic. **Capsule** deep brownish red, claviform, noticeably gibbous on one side prior to dehiscence, including the long neck that often exceeds half the length, 2–3 mm, mostly retaining shape but the neck sulcate when dry and empty; exothelial cell walls slightly thickened,



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oblong (3–4:1) and transversely elongate in 3–5 rows proximal to the mouth; operculum pale in contrast to the pigmented capsule and conic-convex, about as high as wide; peristome teeth reddish brown, narrowly lanceolate ( $85\text{--}100 \times 10\text{--}15 \mu\text{m}$ ), trabeculate basally, becoming hyaline distally and some fusing at the tips, papillose but scarcely striate basally, becoming weakly papillate on the hyaline tips, endostome not seen. **Calyptra** cucullate, long-beaked, inflated around the capsule, smooth. **Spores**  $24\text{--}30 \mu\text{m}$ , with low papillae.

Sandy soil, canyons and desert washes; moderate to high elevations; Ariz., Calif..

The deep red color of the mature sporophytes serves to help identify *Entosthodon rubrisetus* in the field or in the herbarium.

**10. *Entosthodon tucsonii*** (Bartram) Grout, Moss Fl. N. Amer. 2: 81. 1935 [E] [F]



*Funaria tucsonii* Bartram, Bryologist 31: 91, plate 8, figs. G–N. 1928;  
*Physcomitrium haringiae* Grout

**Plants** 2–5 mm, pale yellow-green. **Leaves** variously contorted when dry, oblong-lanceolate to narrowly obovate, imbricate, somewhat concave, mostly 2.5–4 mm; margins serrulate to serrate by

projecting ends of thin-walled cells; apices gradually narrowed to an acumen bearing a filiform tip of 3–4 cells; costa ending 4–7 cells before the awn; basal laminal cells rectangular ( $85\text{--}110 \times 32\text{--}40 \mu\text{m}$ ), distal cells irregularly rectangular to oblong-rectangular, or polygonal, somewhat rhomboid near the margins. **Seta** brownish, 6–10 mm, straight, not hygrosopic. **Capsule** ovoid-pyriform from a long neck approximating half the total length, 2–3 mm, sulcate especially in the neck when dry and empty; exothecial cells scarcely thickened, oblong (2–3:1) and transversely elongate in 5–7 rows proximal to the mouth; operculum rounded-conic; peristome rudimentary or absent, exostome teeth brownish, irregularly blunt tipped, striate-papillose, endostome segments shortly rounded triangular, extending to about



the tooth middle, smooth. **Calyptra** cucullate, long-beaked, inflated around the capsule, large, smooth. **Spores** 32–40  $\mu\text{m}$ , papillose.

Sandy soils, along intermittent desert streams; moderate to high elevations; Ariz., Calif., Colo., Tex.

**11. *Entosthodon rubiginosus*** (R. S. Williams) Grout, Moss Fl. N. Amer. 2: 82. 1935 [E]



*Funaria rubiginosa* R. S. Williams, Bryologist 16: 37, plate 4, figs. 10–19. 1913

**Plants** 3–5 mm, pale yellow-green. **Leaves** slightly contorted when dry, usually broadly ovate, 1.5–2.4 mm; margins entire or nearly so; apices acute to sub-acute, with a subulate tip; costa percurrent to

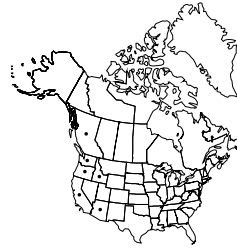
excurent into subula; basal laminal cells rectangular (75–100  $\times$  30–40  $\mu\text{m}$ ), distal cells irregularly hexagonal to oblong rectangular, little differentiated at the margins. **Seta** 5–6 mm, straight. **Capsule** reddish brown with age, pyriform from a narrowed neck about half as long as the sporangium, about 2 mm, changing little when dry and empty, sometimes mouth flaring; exothecial cells thickened, narrowly oblong, with orange-brown walls, transversely elongate in 4–6 rows below the mouth; operculum convex-conic; peristome absent or rudimentary, exostome teeth pale brownish yellow, barely extending beyond the capsule rim and terminating in a rather blunt to short-acute point, slightly papillose, 2–3 articulations present, endostome not seen. **Calyptra** cucullate, long-beaked, inflated around the capsule, large, smooth. **Spores** 25–35  $\mu\text{m}$ , rough (probably bacculate-insulate).

Sandy or silt-rich soil along river banks, gullies, seepage slopes, alkaline sloughs, and washes; moderate elevations; B. C.; Mont., N.Mex., Tex.

Portions of the above description of *Entosthodon rubiginosus* are based upon the original one by Williams.

This species has been found recently at two new locations in British Columbia (T. T. McIntosh, pers. comm.).

**12. *Entosthodon fascicularis*** (Hedwig) Müller Hal., Syn. Musc. Frond. 1: 120. 1848



*Gymnostomum fasciculare* Hedwig, Sp. Musc. Frond., 38, plate 4, figs. 5–9. 1801; *Entosthodon leibergii* E. Britton; *Funaria fascicularis* (Hedwig) Lindberg

**Plants** 2–5 mm, yellow-green. **Leaves** inwardly contorted when dry, oblong to obovate, imbricate, somewhat concave, mostly 2–3

mm; margins serrulate distally by projecting ends of thin-walled cells; costa ending in a subula in distal leaves and ending 1–2 cells before the subula in smaller proximal leaves; apices narrowed to an acumen bearing a short, nearly filiform tip; basal laminal cells rectangular (70–105  $\times$  20–30  $\mu\text{m}$ ), some cells forming a small basal auricle, distal cells irregularly hexagonal to oblong-rectangular, little differentiated at the margins. **Seta** reddish brown with age, 8–10 mm, straight, not hygroscopic. **Capsule** globose-pyriform with a narrow neck less the half the total length, 1–2 mm, sulcate when dry; exothecial cells irregular to hexagonal, little longer than broad; operculum convex; peristome teeth absent or short irregularly pointed, brownish yellow, endostome absent. **Calyptra** cucullate, long-beaked, inflated around the capsule, large, smooth. **Spores** 24–32  $\mu\text{m}$ , bacculate-insulate.

Sandy soil; moderate to high elevations; B.C.; Ariz., Calif., Idaho, Oreg., Wash.; Europe.

**Excluded Species:**

*Entosthodon spathulifolius* Cardot & Thériot

This entity from St. Paul Island collected by Trelease was considered by A. J. Grout (1928–1940, vol. 2) to be a *Tayloria* although he had not seen mature capsules.

**3. FUNARIA** Hedwig, Sp. Musc. Frond., 172. 1801 • [Latin *funis*, rope, alluding to cord-like twisted seta]

Donna H. Miller

Harvey A. Miller

**Plants** small to medium-sized, gregarious or tufted, bright green to yellowish green. **Stems** short, erect, simple except for a short basal antheridial branch. **Leaves** larger and erect distally, reduced proximally, oblong-ovate to broadly obovate distally; concave; apex usually acute or acuminate margins erect, entire to serrate beyond middle; costa single, ending before the tip to excurrent; distal and medial laminal cells large, rhombic-hexagonal to rectangular, lax and rather thin-walled, proximal cells oblong-rectangular, differentiated alar cells absent. **Sexual condition**

autoicous; antheridial branches 1–2, basal, perigonial paraphyses clavate with an enlarged inflated cell; perichaetia apparently absent paraphyses. **Seta** elongate, erect to strongly curved or twisted. **Capsule** exserted, usually inclined to pendent, asymmetric and usually curved, yellow to brown, pyriform, often sulcate or plicate when dry and empty, annulus large and revoluble or not differentiated, exothelial cells oblong-hexagonal to linear, walls incrassate especially so on inner tangential wall, stomata immersed; peristome double, inserted somewhat below the mouth, teeth well developed, obliquely directed, lance-acuminate, papillose-striate, often strongly trabeculate, frequently appendiculate at the tips and fusing with a latticed disk, endostome segments opposite the teeth,  $\frac{1}{6}$  or more the length of the teeth, papillose or weakly papillose-striate with a basal membrane and cilia absent. **Operculum** usually oblique to the axis of the capsule, convex to weakly conic, cells in obliquely radial rows. **Calyptra** large, cucullate, usually smooth, and often long-rostrate. **Spores** spherical, smooth or papillose to baccate-insulate.

Species ca. 200 (9 in the flora): North America, Mexico, West Indies, Central America, South America, Europe, Asia (including Indonesia), Africa, Pacific Islands, Australia.

*Funaria* comprises mainly small to medium seasonal mosses growing on moist mineral or peaty soils in strong light. For the most part, they are relatively short-lived pioneer species adapted to complete the life cycle by producing many spores quickly, in a cool, moist, bright (but not sunny for long periods), exposed, disturbed habitat. In North America, the best time to look for members of the family is spring before the soil dries out. The most common species can be recognized by the production of large numbers of sporophytes bearing a double peristome with inner and outer teeth opposite rather than alternate as is typical for most mosses. The teeth tend to be torqued in one direction with the tips of the exostome adhering weakly to a few-celled disk. Because the sporophyte shows more morphologic diversity than the gametophyte, it is often essential for identification. H. A. Crum and L. E. Anderson (1981) discussed the indistinct generic limits between *Funaria* and *Entosthodon* and the application of generic names.

SELECTED REFERENCES Bartram, E. B. 1928. Studies in *Funaria* from southwestern United States. *Bryologist* 31: 89–96 Fife, A. J. 1979. Taxonomic observations on three species of North American *Funaria*. *Bryologist* 82: 204–214. Ireland, R. R. 1971c. *Funaria*. In: E. Lawton. 1971. Moss Flora of the Pacific Northwest. Nichinan. Pp. 152–154.

1. Annulus absent.
  2. Distal leaves with a long, flexuose, excurrent costa with a hyaline tip . . . . . 6. *Funaria apiculatopilosa*
  2. Distal leaves acute to narrowly acuminate, costa percurrent or, if excurrent, straight and concolorous.
    3. Leaves with acute tips, distal marginal cells serrate from a series of elongate blade cells . . . . . 9. *Funaria serrata*
    3. Leaves with acuminate tips, marginal cells not different from the blade cells.
      4. Costa ending in a narrowly acuminate tip or excurrent, endostome segments broadly triangular proximally and nearly as long as the exostome teeth, east of Rockies . . . . . 7. *Funaria americana*
      4. Costa ending before the slender, filiform acumination, endostome segments narrowly lanceolate and about  $\frac{2}{3}$  the length of the exostome teeth, western states . . . . . 8. *Funaria muhlenbergii*
1. Annulus large, revoluble.
  5. Endostome segments lanceolate, slender pointed, at least  $\frac{2}{3}$  the length of the exostome teeth.
    6. Seta strongly twisted and hygroscopic, 20–80 mm, capsule with an oblique mouth sometimes almost parallel to the axis of the capsule, leaves acute to acuminate, often with a short excurrent costa . . . . . 2. *Funaria hygrometrica*
    6. Seta curved to cygneous, 8–12 mm, capsule mouth scarcely oblique to the axis of the capsule, leaves broadly acute to obtuse, costa ending before or in the tip . . . . . 5. *Funaria arctica*