Keys to the Bryaceae of California

John Spence
March 2018

[Sizes of stems and leaves in the keys are as follows; Stems: short (<10 mm), medium (10-30 mm), long (>30 mm); leaves: small (<1.5 mm), medium (1.5-3 mm), large (3-4 mm), robust (>4 mm); cell length ratio length to width]

1.Stems short, mostly less than 10 mm, julaceous; plants green, yellow-green to silver-white; leaves typically less than 1 mm; distal lamina cells long, (2-)3-10:1, proximal cells quadrate to short-rectangular, transition often abrupt; bulbils sometimes present; dioicous …..……..……2
1. Stems short to long, rarely julaceous (if so then plants reddish); plants green, yellow-green, red, pink-silver, or rarely hyaline above; leaves (0.5-)1-10 mm; distal lamina cells short to long, mostly 2--6:1, proximal cells variously quadrate, short- to long-rectangular, transition abrupt or not; asexual reproduction of all types often present; dioicous or monoicous ……..……..3

2. Plants pale yellow or yellow-green, older plants sometimes forming slender and string-like branches; distal laminal cells elongate (6-)8-10:1, often thick-walled; capsules elongate, ± cylindrical, or erect ……..……..…… *Anomobryum*
2. Plants white, silver-green, golden-yellow, green, or brown-green, older plants with short, rounded strongly julaceous stems or stems gemmiform; distal laminal cells short to moderately long, 2-6(-8):1, mostly thin walled; capsules short, ovate, with thick neck, nodding …….*Bryum*

3. Plants rosulate with obovate to spathulate leaves, margins distally serrate ……..…… *Rosulabryum* (in part)
3. Plants comose to gemmiform, bulbiform or evenly foliate, rarely somewhat rosulate; leaves ovate, ovate-lanceolate to triangular; margins distally smooth to serrulate ……..…….…….4

4. Plants green; laminal areolation homogeneous, cells long, thin walled, (3)4-8:1, cells near apex rarely short or irregularly quadrate, subalar cells similar to adjacent cells; sporophytes sometimes appearing lateral; peristome double, single or absent ……..……..……5
4. Plants green, yellow-green, red-green, purple or red, rarely leaves somewhat hyaline distally; laminal areolation typically heterogenous, distal cells elongate, vermicular, hexagonal, or rhomboidal, thin- to thick-walled, proximal cells quadrate to regularly short- or long-rectangular, alar cells not differentiated although small group of auriculate inflated pink-red subalar cells sometimes present; sporophyte terminal; peristome double .....……..……7

5. Plants small, sometimes julaceous, leaves mostly <1 mm; sporophytes appearing lateral; capsules short pyriform to ovate; apophysis short; peristome of exostome teeth only or absent; rhizoidal tubers absent ……..… *Haplodontium*
5. Plants small to large, leaves small to large; sporophytes terminal; capsules pyriform; apophysis short to long; peristome double; rhizoidal tubers often present ….……6

6. Rhizoidal tubers small, pyriform, brown, 40-60 um; distal lamina cells long and narrow, less than 12 um wide ……..……..……..……..…*Gemmabryum* (in part)
6. Rhizoidal tubers large, spherical, orange to red, often greater than 200 um, or absent; distal lamina cells short, wide, typically greater than 20 um ……..……*Plagiobryoides* (in part)

7. Distal lamina cells 3-6:1, longer than the quadrate or short-rectangular proximal cells; stems gemmiform or elongate and evenly foliate; leaves imbricate, not contorted or twisted when dry, or if somewhat twisted then rhizoidal tubers present; limbidium absent or weak, margins unistratose; rhizoidal tubers and leaf axil bulbils often present ……..8
7. Distal lamina cells mostly 2-4:1, the same length or shorter than the short- to long-rectangular proximal cells; stems comose, to evenly foliate; leaves twisted to strongly contorted when dry; limbidium usually present, often strong, margins uni- or bistratose; rhizoidal tubers and leaf axil filiform gemmae sometimes present, bulbils absent ……..……..9

8. Plants small, stems mostly less than 15 mm, gemmiform to evenly foliate; leaves 0.5-2.5 mm; leaf axil bulbils often present, tubers if present on long rhizoids in substratum or at base of stem, often abundant; capsules ovate to pyriform, apophysis sometimes inflated and rugose ……...*Gemmabryum*
8. Plants medium-sized, stems 1-4(-5) cm, evenly foliate; leaves (1)2-3.5 mm; tubers if present on micronemata or macronemata on stem, scarce, sometimes absent; capsules pyriform to clavate, apophysis slender ……..……*Imbribryum*

9. Main fertile stem leaves ovate to obovate, distal margins serrulate to serrate or rarely nearly smooth, margins unistratose; dioicous; rhizoidal tubers often present .....*Rosulabryum* (in part)
9. Main fertile stem leaves ovate-lanceolate to ovate; distal leaf margins serrulate to often smooth, margins uni to bistratose; dioicous or monoicous; rhizoidal tubers rarely present ……..10

10. Gametangial leaves of fertile stems with auriculate inflated group of pink to red subalar cells; margins unistratose; proximal laminal cells mostly same length and width of distal cells but more rectangular; rhizoidal tubers absent ……*Ptychostomum* in part (subgenus *Cladodium*)
10. Gametangial leaves lacking inflated pink to red subalar cells; margins unistratose to bistratose; proximal laminal cells usually much longer and narrower than distal cells, rectangular, sometimes distal cells very short and wide, occasionally subquadrate; rhizoidal tubers rarely present ……..11

11. Leaf margins bistratose; proximal laminal cells same color as rest of leaf, either green, yellow, pink or red; small patches of colored cell sap present in proximal cells; rhizoidal tubers absent ……..……*Ptychsotomum* in part (subgenus *Ptychostomum*)
11. Leaf margins unistratose; leaf bases typically reddish, colored cell sap absent; rhizoidal tubers sometimes present, either flattened and lobed or spherical to angular ……*Plagiobryoides* (in part)

Anomobryum Schimper (ca. 30 species; 3 in California)

1. Plants strongly julaceous, pale yellow-green to whitish-green; costa not reaching apex or rarely percurrent; distal laminal cells vermicular, strongly incrassate; capsule inclined to nodding; spores 8-14 um ……...…….*Anomobryum julaceum*
1. Plants weakly julaceous, bright green, olive-green to pale yellow-green or whitish-green; costa mostly percurrent to short excurrent; distal laminal cells elongate hexagonal to somewhat vermicular, thin walled to incrassate; capsule inclined, nodding or erect; spores 8-22 um ….....2

2. Plants pale yellow-green to whitish-green; distal laminal cells elongate rhomboidal to ± vermicular, firm walled to incrassate; capsule erect, peristome reduced to single layer; spores 8-14 um; bulbils often present in distal leaf axils; filiform rhizoidal gemmae absent ……...……...……...…*Anomobryum concinnatum*
2. Plants bright green, olive green or yellow-green; distal laminal cells regularly elongate hexagonal, thin to firm walled or weakly incrassate; capsule inclined to nodding, peristome well developed, double; spores 16-22 um; bulbils absent; filiform rhizoidal gemmae sometimes present ……..…….*Anomobryum* sp. 1

Bryum Hedwig (ca. 40 species; 6 in California)

1. Plants silver-green to white-green, sometimes almost pure white ……..2
1. Plants yellow-green, golden, green to olive-green …….…….3

2. Plants whitish, stems mostly evenly foliate, not or weakly julaceous; costa excurrent in long recurved awn; bulbils absent ……*Bryum lanatum*
2. Plants silver-green, rarely mostly green; stems strongly rounded julaceous to gemmiform; costa not reaching apex; apiculus present, sometimes short, recurved or straight; bulbils often present in axils of distal leaves on sterile shoots ……..……...……*Bryum argenteum*

3. Distal laminal cells of leaves elongate hexagonal to vermicular, narrow, 6:1 or more, <12 um wide; leaf base yellow, green or red ……...……4
3. Distal laminal cells on all leaves shorter, rhomboidal to hexagonal, wide, 2-4:1, 10-25 um wide, leaf base green …….……..5

4. Plants shiny golden-yellow or golden-green; costa long excurrent in slender colored awn; bulbils absent …….……*Bryum chryseum*
4. Plants dull green to yellow-green; costa not reaching apex or sometimes percurrent; bulbils sometimes present in axils of distal leaves on vegetative shoots …….....…….*Bryum blindii*

5. Leaf apex broadly rounded to subacute, cucullate; stems strongly julaceous; distal laminal cells broadly and irregularly rhomboidal, 12-25 um wide, proximal cells mostly quadrate ……...……*Bryum calobryoides*
5. Leaf apex acute, not cucullate; stems evenly foliate to weakly julaceous; distal laminal cells hexagonal, 10-16 um wide, proximal cells mostly short-rectangular …….…….*Bryum veronense*

Gemmabryum J.R. Spence & H.P. Ramsay (ca. 120 species; 20 in California)

1. Plants with bulbils in axils of distal stem leaves (sterile material!) ……2
1. Plants lacking bulbils ……7

2. Mature bulbils 1(2) per axil, up to 750 um long, leaf primordia arising from below or middle of bulbils ……..*Gemmabryum dichotomum*
2. Mature bulbils (1)2-many per axil, <450 um, if leafy then primordia arising from upper ½ to ¼ of bulbil ……3

3. Bulbils 150-450 um, pyriform to conic or cylindric, primordia present and distinct ……4
4. Bulbils 40-200 um, obconic to keyhole shaped or spherical to oval, primordia absent or very short and peglike ……5

4. Bulbils 200-450 um, primordia broad, leafy, obtuse to acute ……*Gemmabryum barnesii*
4. Bulbils 150-250 um, primordia narrow, peglike, acute ……*Gemmabryum gemmiferum*

5. Bulbils 40-70 um, keyhole shaped, often hundreds present as a green powdery mass in upper leaf axils ……*Gemmabryum calfornicum*
5. Bulbils 100-200 um, spherical to oval, (2)3-25 per axil ……6

6. Costa excurrent in long, hyaline denticulate awn; bulbils with groove across tip between peglike primordia; introduced ……*Gemmabryum eremaeum*
6. Costa percurrent to short excurrent in colored smooth awn; bulbils lacking apical groove, primordia present or absent; widespread ……..*Gemmabryum gemmilucens*

7. Rhizoidal tubers present, common (sterile material!) ……8
7. Tubers lacking or rare and difficult to locate ……..15

8. Mature tubers small, <100 (125) um in longest axis ……..9
8. Mature tubers larger, many >130 um in longest axis, to 400 um ……..12

9. Laminal cells elongate hexagonal, >5:1, some cells >80 um long, through most of leaf except at extreme base; tubers small, pyriform, 60-80 um in longest axis, brown ……*Gemmabryum valparaisense*
9. Laminal cells shorter, mostly 3-4:1, mostly <60 um long, proximal cells shorter, quadrate to short-rectangular across leaf base; at least some tubers 80-120 um, spherical to pyriform ……10

10. Rhizoids violet, purple or sometimes red-purple; tubers irregularly spherical, purple-red to orange ……..*Gemmabryum violaceum*
10. Rhizoids pale, yellowish, brown, tan or red-brown; tubers spherical to pyriform, yellow, orange-brown, red or crimson ……11

11. Most tubers pyriform, yellow, orange to red-brown, in clusters of 2-5 on short lateral rhizoids of main rhizoids at or near stem base ……..……...*Gemmabryum demaretianum*
11. Tubers mostly spherical, red to crimson, on long rhizoids in soils, not clustered ……..…….*Gemmabryum klinggraeffii*

12. Rhizoidal tubers orange to yellow; rhizoids brown, red-brown or yellow …….13
12. Rhizoidal tubers red-brown to red, rhizoids brown to red-brown ….…….14

13. Rhizoidal tubers 100-300 um, spherical, yellow or rarely pale orange; rhizoids pale yellowish; costa excurrent in short to long awn; plants often with reddish tints ……..……..*Gemmabryum tenuisetum*
13. Rhizoidal tubers large, angular to spherical, at least some >400 um, orange, rhizoids red-brown to brown; costa short-excurrent; plants green or yellow-green …...…..*Gemmabryum* sp. 1

14. Costa short-excurrent, awn red-brown; proximal laminal cells short-rectangular; rhizoidal tubers often >200 um; generally on acidic substrates ..……*Gemmabryum subapiculatum*
14. Costa short to long-excurrent in pale yellow to reddish colored awn; proximal laminal cells quadrate; rhizoidal tubers <200 um; generally on calcareous substrates ……*Gemmabryum radiculosum*

15. Costa excurrent in long colored awn; plants with distinct narrow limbidium; gametangial leaves with small auriculate group of inflated ± pinkish-red cells; short innovations with rudimentary leaves often present in axils of distal stem leaves ……..…..16
15. Costa excurrent in short awn, if longer than often hyaline and upper lamina partly hyaline; innovations with rudimentary leaves absent, or if present then costa often medium to long excurrent in hyaline awn; subalar group of cells absent ….……..……17

16. Leaves strongly concave, costal awns >1/2 leaf length, often equal to lamina, ± denticulate; rhizoidal tubers absent ……..……*Gemmabryum badium*
16. Leaves somewhat concave, costal awns <1/2 leaf length, ± smooth; rhizoidal tubers rarely present …….……..*Gemmabryum caespiticium*

17. Plants dark red, sometimes dark olive-green; costa excurrent in long red awn, tip often hyaline and spinulose; capsules cylindric; rhizoizal tubers rarely present ……..…….*Gemmabryum vinosum*
17. Plants pale green, yellow-green or golden, lacking red tints; leaves imbricate to loosely set; costa variable, not reaching apex, percurrent, short or long excurrent, sometimes upper laminal and awn hyaline; capsules cylindric or pyriform, tubers absent ….…….…….18

18. Plants green to green-yellow, apices sometimes hyaline; leaves comose to weakly intricate or loosely set; distal laminal cells thin walled, costa variable, not reaching apex to long-excurrent into often hyaline awn, sometimes on the same shoot; capsule pyriform ……*Gemmabryum kunzei*
18. Plants strongly gemmiform, with tightly imbricate yellow-green to golden-green leaves; distal laminal cells ± incrassate, costa percurrent to short-excurrent in stout colored awn; capsule cylindric ……..*Gemmabryum brassicoides*

Haplodontium Hampe (ca. 15 species; 2 in California)

1. Leaves somewhat flexuose to secund when dry, margins revolute proximally, distal laminal cells elongate, >4:1; peristome single, operculum flat to weakly convex, weakly apiculate; Sierra Nevada Mtns ……*Haplodontium macrocarpum*
1. Leaves imbricate when dry, stems somewhat julaceous, leaf margins plane, distal laminal cells short, short-rectangular to subquadrate, mostly <3:1; peristome absent, operculum distinctly convex, umbonate; endemic to Lassen Volcano ……..…….....….……*Haplodontium tehamense*

Imbribryum Pedersen (ca. 40 species; 7 in California)

1. Leaves rigid, strongly imbricate when dry, lanceolate to narrowly ovate-lanceolate; distal laminal cells long, incrassate and vermicular, 6-10:1 ……2
1. Leaves rigid to somewhat loosely imbricate when dry, ovate to ovate-lanceolate; distal lamina cells shorter, not or rarely vermicular, mostly 3-5(6):1, thin walled to incrassate ……3

2. Plants dark green to red, often shiny, costa percurrent to short-excurrent; limbidium absent; proximal laminal cells gradually wider proximally, short-rectangular to quadrate, leaves not decurrent; capsule pyriform with short neck, spores 10-16 um; on mineralized rock ……*Imbribryum alpinum*
2. Plants pale green, yellow-green to golden, somewhat dull, costa short to moderately long-excurrent into a slender sometimes denticulate awn, often reddish; weak to moderately strong limbidium present; proximal laminal cells abruptly enlarged, somewhat bulging-hyaline, rectangular, leaf decurrencies present, of inflated cells; capsule long with distinct apophysis; spores 18-25 um; various substrates ……..*Imbribryum microchaeton*

3. Stems distinctly julaceous; leaves concave, apex broadly rounded to obtuse, awn not reaching apex to percurrent ....…….....……4
3. Stems imbricate but not distinctly julaceous; leaves flat to somewhat concave, leaf apex acute to acuminate, costa percurrent to short-excurrent …….....…….6

4. Leaves green to yellow-green, lacking red tints, loosely set, somewhat distant proximally along stem, leaf apex with small apiculus sometimes present, distal laminal cells thin walled, proximal laminal cells quadrate mixed with short-rectangular cells, cells at base same as cells above, not colored or inflated; strong calciphile ……...……...*Imbribryum gemmiparum*
4. Leaves becoming purple, red or blackish with age or dull olive-green, more or less rigid, strongly imbricate; leaf apex lacking apiculus; distal laminal cells thin walled to incrassate, proximal laminal cells quadrate, 1-2 rows of colored slightly inflated cells often present at leaf base; neutral habitats to strong acidophiles …….....…….5

5. Costa percurrent; distal lamina cells incrassate, oblique to costa, proximal laminal cells often enlarged to inflated and colored in 1-2 rows across leaf base; widespread …….. *Imbribryum miniatum*

5. Costa not reaching apex or rarely percurrent; distal lamina cells thin to somewhat firm-walled, parallel to costa, cells at leaf base not inflated although sometimes colored; acidic to mineralized rock ……...….*Imbribryum muehlenbeckii*

6. Plants yellow, golden or green, lacking reddish tints, older leaves becoming stramineus with age; leaves flat or weakly concave, slender ovate-lanceolate, apices acute to acuminate; costa percurrent to short-excurrent in slender awn; rare, mostly higher elevations, on wet rock or soil in wetlands ……...…. *Imbribryum mildeanum*
6. Leaves red or red-green, red tints usually present, costa short-excurrent in stout point, older leaves becoming dull brown; leaves somewhat concave, ovate, apex broadly acute; widespread ……..…….……..…….*Imbribryum torenii*

Plagiobryoides J.R. Spence (ca. 20 species; 2 in California)

1. Leaves weakly concave, not decurrent, mostly contorted when dry, apex acute; costa percurrent to short-excurrent; mature rhizoidal tubers large, to 500 um, irregularly spherical to angular, orange to red ……..…….…….*Plagiobryoides vinosula*
1. Leaves strongly concave, somewhat decurrent, weakly contorted to somewhat imbricate when dry, apex broadly acute to obtuse; costa not reach apex to percurrent; mature rhizoidal tubers consisting of flattened lobed sheets, ca. 500-1000 um across …….……*Plagiobryoides* sp. 1

Ptychostomum Hornschuch (ca. 70 species; 20 in California)

1. Dioicous or rarely synoicous (1 species); mostly medium to robust plants with evenly foliate stems, stems often >4 cm; costa percurrent to short-excurrent in short awn ……...…..2
1. Dioicous, autoicous, synoicous or polyoicous; plants smaller, loosely tufted to comose, not or shortly evenly foliate, stems mostly <2 (3) cm; costa percurrent to long excurrent .....….9

2. Leaves distinctly decurrent, decurrencies long …….…….3
2. Leaves not decurrent or weakly decurrent. decurrencies short ……..4

3. Plants green or pink; stems not matted with rhizoids; , leaves uniform in color, decurrencies long, broadly triangular, reaching next leaf below; margins bistratose, laminal cells thin walled; capsule turbinate to short pyriform …….…….……*Ptychostomum weigelii*
3. Plants green, green-yellow or red-green; stems often densely matted with rhizoids; leaves with contrasting red base, decurrencies slender, linear, not reaching next leaf below; margins unistratose, distal laminal cells ± incrassate; capsule long-ovate to clavate or cylindric …….……..…*Ptychostomum pseudotriquetrum*

4. Synoicous; stems often matted with rhizoids; leaf margins unistratose; capsule elongate-clavate to pyriform …….……..…….*Ptychostomum bimum*
4. Dioicous; stems with or without matted rhzioids; leaf margins unistratose to bistratose; capsule elongate-clavate, cylindrical or turbinate ……. .....….5

5. Leave ovate to orbicular, leaf apex rounded to obtuse, margins unistratose or bistratose ...….6
5. Leaves ovate to ovate-lanceolate, apices acute, margins bistratose ……..…….7

6. Leaves strongly collapsed and shrunken when dry, broadly ovate to orbicular, ± flat, distal laminal cells thin walled, proximal laminal cells much longer than cells above, margins bistratose, filiform gemmae sometimes present in leaf axils and on stems ……..……*Ptychostomum cyclophyllum*
6. Leaves irregularly contorted when dry, broadly ovate, concave, distal laminal cells ± incrassate, proximal laminal cells more or less same length as cells above, margins unistratose; filiform gemmae absent …….*Ptychostomum neodamense*

7. Leaves ± imbricate when dry, broadly ovate, yellowish to copper-colored; distal laminal cells extremely broad, many cells 25-35 um wide; capsule turbinate …….*Ptychsotomum schleicheri*
7. Leaves somewhat imbricate to contorted or flexuose when dry, narrowly ovate to ovate-lanceolate, bright green, yellow-green or dull green; distal laminal cells narrower, 15-25 um; capsule elongate cylindric-clavate or turbinate ……..8

8. Plants dull green to yellow-green, stems mostly <4 cm, leaves broadly ovate-lanceolate, margins mostly plane, rarely revolute at base, cells near leaf tip not distinctly colored or incrassate, perigonial leaves not much enlarged; capsule turbinate …..*Ptychostomum turbinatum*
8. Plants bright green to yellow-green, stems often >8 cm, to 12 cm, leaves narrowly elongate ovate to ovate-lanceolate, margins revolute proximally, cells near leaf tip colored, incrassate; perigonial leaves greatly enlarged, conspicuous; capsule elongate-cylindric to clavate ……..…….*Ptychostomum pacificum*

9. Leaf color ± uniform, leaf base same color; plants loosely tufted, often shortly evenly foliate, limbidium bistratose, proximal laminal cells generally much longer than cells above; gametangial leaves lacking auriculate subalar group of inflated pink to red cells; capsule long, often curved-asymmetric ……...…....……10
9. Leaf color various, but leaf bases often reddish and different in color from rest of leaf, plants tufted to comose or sometimes evenly foliate, limbidium unistratose, proximal laminal cells mostly same length as cells above, more regularly rectangular; auriculate group of inflated pink-red cells present on gametangial leaves; capsules mostly straight, short to long (capsule and spores needed beyond this) .....……..……12

10. Leaves with costa excurrent in medium to long awn, plants reddish or with red tints; polyoicous, with synoicous shoots and female-only shoots; spores 24-32 um; alpine ……..…….*Ptychostomum arcticum*
10. Leaves with costa percurrent to short-exucrrent in slender point, plants green to pink, rarely red; dioicous or autoicous; spores 16-36 um; low to high elevations ...……...……11

11. Plants green to pink, pink coloration usually present; dioicous; peristome well-developed, cilia present; spores 16-22 um ……..*Ptychostomum pallens*
11. Plants green to yellow-green, pink colors absent; autoicous; peristome reduced, cilia absent; spores 28-36 um …….*Ptychostomum cernuum*

12. Synoicous; plants strongly comose-caespitose; capsule short-pyriform, cilia short or absent; endostome and exostome fused, giving the teeth a chambered appearance; spores 25-35 um ……...*Ptychostomum pendulum*
12. Synoicous, autoicous or polyoicous; plants comose to evenly foliate or loosely tufted; cilia present or absent; endostome not adherent to exostome; spores 12-30 um ……..……..13

13. Leaves ovate, ± concave, costa percurrent to excurrent as short awn ……...……..14
13. Leaves ovate, lingulate to ovate-lanceolate, flat to somewhat concave; costa excurrent in long awn ……15

14. Synoicous; leaves strongly concave, distinctly keeled; limbidium narrow, (1)2 rows or indistinct; capsule short-ovate, symmetric, spores 20-30 um ……..*Ptychosotmum knowltonii*
14. Polyoicous, female-only shoots often present; leaves weakly concave, not strongly keeled; limbidium strong, (1)2-3 rows; capsule elongate-pyriform, slightly curved-asymmetric; spores 15-25 um ……...…*Ptychostomum nitidulum*

15. Autoicous; leaves loosely set, somewhat evenly foliate, ovate-lanceolate to lingulate; spores 18-20(22) um ……..……*Ptychostomum pallescens*
15. Synoicous or polyoicous; leaves mostly in comose tufts, ovate-lanceolate; spores 10-24 um ...……..……..…16

16. Capsules short-pyriform; leaves densely comose-tufted; cilia often reduced or short, sometimes absent; spores (18)20-24 um; predominantly montane …….*Ptychostomum inclinatum*
16. Capsule elongate pyriform to clavate or cylindric; leaves densely to loosely comose-tufted; cilia present, long; spores 10-16 um; widespread …….....17

17. Synoicous; limbidium narrow, (1)2-3 rows, yellowish …..……..*Ptychostomum creberrimum*
17. Polyoicous; synoicous with female-only shoots; limbidium wide, (2)3-5 rows, same color as adjacent cells …….…….…….*Ptychostomum lonchocaulon*

Rosulabryum J.R. Spence (ca. 80 species; 12 in California)

1. Shoots often consisting of a series of interrupted comal tufts; leaves large, (2)3-4 mm, costa short excurrent in stout recurved awn, distal leaf margins coarsely serrate; autoicous; tubers large, often >300 um, red to scarlet or orange ……..……*Rosulabryum canariense*
1. Shoot mostly in single rosettes or sometimes evenly foliate; leaves small to medium, mostly <3 mm, costa not reach apex to long excurrent, awns if present generally not recurved, distal margins serrate to nearly smooth; dioicous, synoicous, or polyoicous; tubers mostly <300 um, colors various …….…….…….……..2

2. Filiform leaf axil gemmae present (sterile shoots!) ..……..……3
2. Filiform leaf axil gemmae absent …….…….…….5

3. Plants mostly green; innovations short rosulate, leaves ± flat, predominantly obovate, distal leaf margins distinctly serrulate; often on wood ……..…….*Rosulabryum laevifilum*

3. Plants green to red-green or red-brown; innovations evenly foliate with concave mostly ovate leaves; distal margins weakly serrulate to smooth; substrates various ……..…….4

4. Plants consisting mostly of slender innovations with green to red-green leaves, sometime spirally twisted; costa weak, not reaching apex to percurrent, if short-excurrent awn colored ……..……..…….*Rosulabryum flaccidum*
4. Plants with rosulate main stems, innovations with dark red-brown leaves, rarely spirally twisted; costa mostly excurrent in short awn, often with hyaline tip ……....*Bryum (Rosulabryum) sanguilentum* (=*R. gemmascens*)

5. Leaves ovate, distal leaves spirally twisted around stem; costa short-excurrent in stout awn; stems often long, to 4 cm ..…….....……*Rosulabryum* sp. 1
5. Leaves contorted or sometimes nearly imbricate, if spirally twisted around stem then awns long or filiform gemmae present; stems mostly <2 cm ……..……6

6. Plants synoicous or polyoicous ……..……..……..…….7
6. Plants dioicous ……9

7. Plants small, leaves mostly <2 mm, irregularly contorted when dry; limbidium weak; tubers pale orange, amber to brown …….……*Rosulabryum bornholemse*
7. Plants medium-sized, leaves 2-3 mm, irregularly contorted to spirally twisted when dry; limbidium weak to strong; rhizoidal tubers red to scarlet .....……8

8. Synoicous; distal leaf margins finely serrulate, leaves spirally twisted around stem, limbidium narrow, weak or indistinct; known only from The Cedars, Sonoma County …..*Rosulabryum* sp. 2
8. Synoicous to polyoicous; distal leaf margins strongly serrulate to serrate, leaves irregularly contorted; limbidium strong, distinct; common, widespread …….…....*Rosulabryum torquescens*

9. Stems evenly foliate, ± julaceous; leaves predominantly ovate, strongly concave, costa excurrent in medium to long awn; rhizoidal tubers lacking ……..….*Rosulabryum elegans*
9. Stems rosulate to evenly foliate, not julaceous; costa and awn various but rarely long, if so then leaves obovate; rhizoidal tubers present ……...……10

10. Plants generally maroon, red or with strong red tints; leaves obovate, distinctly decurrent, costa variable, not reaching apex to short-excurrent …..……..……..*Rosulabryum erythroloma*
10. Plant color various, green, yellow-green, red-green to brown, rarely strongly red; leaves not or only weakly decurrent, ovate to obovate, costa variable, not reach apex to long-excurrent …11

11. Leaves obovate, distinctly spirally twisted around stem when dry; costa excurrent in long awn …….……..….*Rosulabryum capillare*
11. Leaves obovate to ovate, irregularly flexuose-contorted, not spirally arranged around stem; costa variable, not reaching apex, percurrent or exucrrent in short or medium length awn ….....12

12 Plants green or yellow-green, leaves more or less flat, distal margins serrulate; innovations short, rosulate, leaves predominantly obovate ……...…….*Rosulabryum laevifilum*

12. Plants green, yellow-green, to red-brown, leaves concave, distal margins serrulate to ± smooth; innovations short and rosulate or evenly foliate, leaves predominantly ovate …..…….13

13. Distal leaf margins distinctly serrulate, limbidium present; tubers red, cells distinctly protuberant ...……..…….*Rosulabryum rubens*
13. Distal leaf margins smooth to weakly serrulate, limbidium present or absent; tubers smooth, brown, red-brown or red (search for filiform leaf axil gemmae!) ….……...……. 4

Genera: 8; Species and distinct forms: 74

Red: new species not yet described, known from several to many collections; in keys
Yellow: unknown taxa that may be new but based on a single collection; not in keys

Anomobryum (3)	
concinnatum	IN
julaceum	IN
Species 1 "Lake County"	EN (northern CA)
Bryum (6)	
argenteum	
var. argenteum	IN
var. muticum	IN
blindii	IN
calobryoides	IN
chryseum	PI
lanatum	IN
veronense	IN
Gemmabryum (21)	
badium	IN
caespiticium	IN
kunzei	IN
barnesii	IN
brassicoides	EN
californicum	EN
dichotomum	IN
eremaeum	EX
gemmilucens	IN
gemmiferum	PI
vinosum	IN
demaretianum	LI
klinggraeffii	LI
radiculosum	IN
Species 1"rheophytum"	IN (south-central CA, south Arizona)
subapiculatum	IN
tenuisetum	LI
valparaisense	IN
violaceum	LI
"insularis"	EN (1 collection – Channel Islands)
"vinocostata"	EN (1 collection – S. California)
Haplodontium (2)	
tehamense	EN
macrocarpum	IN

Imbribryum (7)

alpinum	IN
gemmiparum	IN
microchaeton	IN
mildeanum	IN
miniatum	IN
muehlenbeckii	IN
torenii	IN

Plagiobryoides (3)

"insularis"	EN (1 collection – Channel Islands)
vinosula	IN
Species 1 "flabelliformis"	IN (fairly widespread; mis-id as P. renauldii)

Ptychostomum (20)

arcticum	IN
bimum	IN
cernuum (tentative)	IN
creberrimum	IN
cyclophyllum	IN
inclinatum	IN
knowltonii	IN
lonchocaulon	IN
pendulum	IN
pallescens	IN
neodamense	IN
nitidulum	IN
pacificum	IN
pallens	IN
pendulum	IN
pseudotriquetrum	IN
schleicheri	IN
turbinatum	IN
weigelii	IN

Rosulabryum (12)

Species 1 "basalticum"	EN (widespread; mimics Pty. pseudotriquetrum, I. torenii)
[bornholmense (tentative)	LI]
canariense	IN
capillare	IN
elegans	IN
erythroloma	IN
flaccidum	IN
laevifilum	IN
rubens	LI

sanguilentum	IN (=R. gemmascens; sanguilentum has priority)
Species 2 “serpentinicola”	EN (The Cedars)
torquescens	IN

1	EX=Exotic (confirmed introduced)
10	EN=Endemic
55	IN=Indigenous
6	LI=Likely introduced
2	PI=Possibly introduced; may be native but hard to determine