

# ASTERACEAE (Compositae) SUNFLOWER FAMILY

David J. Keil, except as noted

Ann to tree. **LF:** basal and/or cauline, alternate, opposite, rarely whorled, simple to 2+ × compound. **INFL:** 1° infl a head, resembling a fl, of several types (see below), 1–many in gen ± cyme-like cluster; each head gen with ± calyx-like involucle of 1–many series of phyllaries (involucral bracts); receptacle of head flat to conic or columnar, paleate (bearing paleae = receptacle bracts) or epaleate; fls 1–many per head. **FL:** bisexual, unisexual, or sterile, ± small, of several types (see below); calyx 0 or modified into ± persistent pappus of bristles, scales, and/or awns; corolla radial or bilateral (0), lobes gen (0)3–5; stamens 4–5, filaments gen free, gen fused to corolla at tube/throat junction, anthers gen fused into cylinder around style, anther base gen rounded or cordate (deeply sagittate or with tail-like appendages), tip (= flattened appendage) gen projecting beyond pollen sac; pistil 1, 2-carpeled, ovary inferior, 1-chambered, 1-seeded, placenta basal, style 1, tip gen ± 2-branched (exc in some staminate disk fls), branch tips truncate or gen bearing ± brush-like appendages; stigmas 2, gen on adaxial faces of style branches. **FR:** achene (also called a cypsela) (drupe in *Chrysanthemoides*), cylindric to ovoid, sometimes compressed, gen deciduous with pappus attached. ± 1500 genera, 23000 spp.: worldwide, many habitats. Fl and head types differ in form and sexual condition. A disk fl has a gen radial corolla, with a cylindric tube, expanded throat, and gen 5 lobes. Disk fls are gen bisexual and fertile but occ staminate with reduced ovaries. Discoid heads comprise only disk fls. A radiant head is a variant of a discoid head, with peripheral disk fl corollas expanded, often bilateral. A ray fl corolla is bilateral, gen with a slender tube and flattened petal-like ray (single lip composed of gen 3 lobes). Ray fls are gen pistillate or sterile (occ lacking styles). Radiate heads have peripheral ray fls and central disk fls. Disciform heads superficially resemble discoid heads, with pistillate or sterile fls that lack rays, together with or separate from disk fls. A ligulate fl is bisexual, with a bilateral, gen ephemeral corolla and 5-lobed ligule. Liguliflorous heads comprise only ligulate fls. See glossary p. 31 for illustrations of family characteristics. *Echinops sphaerocephalus* L., *Gaillardia aristata* Pursh, *G. pulchella* Foug., *Hymenothrix loomisii* S.F. Blake, *Tagetes erecta* L., *Thelesperma megapotamicum* (Spreng.) Kuntze are waifs. *Melampodium perfoliatum* Kunth, historic urban waif. *Ageratum conyzoides* L., *Guizotia abyssinica* (L. f.) Cass., *Santolina chamaecyparissus* L., orth. var. are rare or uncommon escapes from cult. *Dyssodia papposa*, *Ismelia carinata* (Schousb.) Sch. Bip. [*Chrysanthemum carinatum* Schousb.], *Mantisalca salmantica* (L.) Briq. & Cavill. are historical or extirpated waifs in CA. *Inula helenium* L. not documented in CA. Taxa of Aster in TJM (1993) treated here in *Almutaster*, *Eucephalus*, *Eurybia*, *Ionactis*, *Oreostemma*, *Sericocarpus*, *Symphyotrichum*; *Chamomilla* in *Matricaria*; *Cnicus* in *Centaurea*; *Conyza* in *Erigeron* and *Laennecia*; *Dugaldia* in *Hymenoxys*; *Erechtites* in *Senecio*; *Hymenoclea* in *Ambrosia*; *Lembertia* in *Monolopia*; *Osteospermum ecklonis* in *Dimorphotheca*; *Picris echioides* in *Helminthotheca*; *Prionopsis* in *Grindelia*; *Raillardiopsis* in *Anisocarpus* and *Carlquistia*; *Schkuhria multiflora* in Bahia; *Trimorpha* in *Erigeron*; *Venidium* in *Arctotis*; *Whitneya* in *Arnica*. Scientific Editors: David J. Keil, Bruce G. Baldwin.

## Key to Groups

1. None of fls of head with strap-shaped corollas that resemble spreading petals [ligulate fls 0, ray fls 0 or rays very short and easily overlooked]; heads discoid, disciform, or radiant
2. Fls of 2 kinds, in same or different heads
  3. Heads radiant; corollas of outer fls [bisexual or sterile] conspicuously expanded, often ± bilateral. . . . . **Group 1**
  - 3'. Heads disciform [pistillate or sterile fls and bisexual or staminate fls] or unisexual, corollas of pistillate or sterile fls inconspicuous or 0. . . . . **Group 2**
  - 2'. Fls of 1 kind [disk fls] — heads discoid
    4. Receptacle bearing scale-like bracts [paleae] that gen individually subtend disk fls or bearing hair-like bristles or tooth-like to membranous or bristle-like scales among fls
      5. Receptacle paleate or bearing tooth-like to membranous scales . . . . . **Group 3**
      - 5'. Receptacle bristly or of long, bristle-like scales (free or fused at base) . . . . . **Group 4**
      - 4'. Receptacle epaleate or paleae only marginal and simulating phyllaries (sometimes bearing minute scales or short hairs among fls)
        6. Pappus 0 or only a low crown . . . . . **Group 5**
        - 6'. Pappus well developed
          7. Pappus of bristles (sometimes with an additional series of shorter bristles or scales) . . . . . **Group 6**
          - 7'. Pappus of flat, ± membranous scales or stiff, ± needle-like awns . . . . . **Group 7**
      - 1'. Some or all fls of head with strap-shaped corollas or corolla lips [ligules or rays] that resemble spreading petals; heads liguliflorous, composed of 2-lipped fls, or radiate
        8. Head composed of 1 kind of fl; central fls sometimes smaller or less mature but all bisexual and with same kind of corolla
          9. Head liguliflorous; corolla 1-lipped, the spreading, petal-like ligule tipped by 5 short lobes [ligulate fls];
            - 9'. Corolla readily withering; sap milky . . . . . **Group 8**
            - 9'. Head composed of 2-lipped fls; outer corolla lip shallowly 3-lobed, spreading, resembling ray of ray fl, inner lip deeply 2-lobed, recurved or coiled; corolla not readily withering; sap clear . . . . . **Group 9**
            - 8'. Head radiate, composed of 2 kinds of fls; outer fls [ray fls] pistillate or sterile, corolla bilateral with gen spreading, petal-like lip [ray]; inner fls [disk fls] bisexual (staminate) with gen radial, (4)5-lobed tubular corolla
              10. Receptacle bearing scale-like bracts [paleae] that gen individually subtend disk fls (sometimes only a single ring of paleae separate ray and disk fls) . . . . . **Group 10**
              11. Phyllaries in 1(2) series, each subtending a ray fl . . . . .

- 11' Phyllaries in 2+ series, not all subtending ray fls ..... Group 11  
 10' Receptacle epaleate or bearing minute scales or hairs (rarely long bristles or awn-like projections) among fls ..... Group 12  
 12. Pappus 0 or only a low crown ..... Group 12  
 12' Pappus well developed on ray or disk frs (or both)  
   13. Pappus of flat, ± membranous scales or stiff, ± needle-like awns ..... Group 13  
   13' Pappus of bristles (sometimes with an additional series of shorter bristles or scales) ..... Group 14  
   14. Rays white to pink, blue, or purple ..... Group 15  
   14' Rays yellow to orange or red ..... Group 15

**Group 1**

Heads radiant; corollas of outer fls enlarged, often ± bilateral

1. Phyllaries graduated in 4–8 series ..... **LESSINGIA** (G6,7)
2. Outer fls fruiting ..... *Tanacetum bipinnatum*
3. Pappus of bristles; ann, taprooted ..... *CENTAUREA* (G2,4)
- 3' Pappus a crown of short scales; per with rhizome ..... *VOLUTARIA* (G4)
- 2' Outer fls sterile ..... *PALAFOXIA* (G7)
4. Distal phyllary margin expanded as a spiny-margined, fringed, or irregularly toothed appendage ..... *HYMENOTHRIX* (G7)
- 4' Distal phyllary margin entire, tapered smoothly to tip-spine ..... *Arnica discoidea*
- 1' Phyllaries ± equal or weakly graduated in 1–3 series ..... *CHAENACTIS* (G7)
5. Fr 10–15 mm ..... *TRICHOPTILIUM* (G6,7)
- 5' Fr 2–9 mm ..... *Xanthium spinosum*
6. Phyllary margin thin, ± scariosus, brown to purple ..... *Xanthium strumarium*
- 6' Phyllary margin not or scarcely scariosus, variously colored ..... *BACCHARIS* (G6)
7. Lvs opposite ..... *ANAPHALIS* (G6)
- 7' Lvs alternate ..... *ANTENNARIA* (G6)
8. Pappus scales entire or fringed; lf entire to ± deeply 1–2-pinnately lobed ..... *SOLIVA*
- 8' Pappus scales dissected into bristles; lf sharply dentate or with a few short, sharp lobes ..... *DICORIA*

**Group 2**

Heads disciform or unisexual; fls of 2 kinds or of 1 unisexual kind; corollas of pistillate or sterile fls inconspicuous

1. Pistillate and staminate fls in different heads
2. Pistillate and staminate heads on same pl [monoecious]
3. Subshrub or shrub (to small tree) ..... <sup>2</sup>*AMBROSIA*
- 3' Herb
  4. St armed with 3-branched spines ..... *Xanthium spinosum*
  - 4' St unarmed
    5. Staminate heads well-spaced in long terminal infl; bur 2–10 mm ..... <sup>2</sup>*AMBROSIA*
    - 5' Staminate heads congested; bur 10–30+ mm ..... *Xanthium strumarium*
  - 2' Pistillate and staminate heads on different pls [dioecious]
    6. Shrub or erect herb with sticky lvs, not woolly ..... *BACCHARIS* (G6)
    - 6' Herb, sometimes prostrate, not sticky; pl gen ± woolly
      7. St from rhizome; lf rosette withered at fl; cauline lvs long, all exc distal-most ± equal ..... <sup>2</sup>*ANAPHALIS* (G6)
      - 7' St from persistent lf rosette or thick, often branched caudex; cauline lvs gen ± reduced, at least distal-most short, 1–3 cm ..... *Euphorsyne acerosa*
  - 1' Pistillate or sterile fls in same head as staminate or bisexual fls
    8. Outer fls without corollas; heads not embedded in woolly hairs
      9. Heads solitary; pl low, sts often spreading or prostrate
        10. Head on slender ± lfless peduncle; outer frs stalked, not spine-tipped
          - 10' Head sessile near st base or at branch tips, ± enveloped by sheathing bases of opposite or whorled subtending lvs, overtopped by branches; fr sessile, spine-tipped ..... *COTULA*
        - 9' Heads in raceme- or panicle-like clusters
          11. Ann; fr smooth or warty, gen winged, glabrous or hairy ..... *SOLIVA*
          - 11' Subshrub or shrub; fr long-soft-hairy, not winged ..... *DICORIA*
      - 8' Outer fls with (sometimes narrowly cylindric) corollas; heads sometimes embedded in woolly hairs
        12. Outer fls sterile; head not very small, not embedded in woolly hairs
          13. Cauline lvs gen bladeless, sheathing; basal lvs from creeping rhizome, often appearing after fl st, long-petioled, palmately lobed ..... *PETASITES* (G14)
          - 13' Cauline lvs with blades, sometimes reduced distally on st, not sheathing; basal lvs 0 or from taproot, appearing before fl st, sessile or petioled, entire to 1–2-pinnately lobed ..... *CRUPINA* (G3)
          14. Fertile fls 1–2 per head ..... *Centaurea benedicta* (G4)
          - 14' Fertile fls many per head ..... *CRUPINA* (G3)
        15. Lf spiny ..... *Centaurea benedicta* (G4)

- 15' Lf not spiny  
 16. Pappus of awns with reflexed barbs; phyllaries in 2 series, unarmed ..... **BIDENS** (G3,11)  
 16' Pappus 0 or of smooth or minutely rough bristles or narrow scales; phyllaries graduated in 6+ series, often fringed or spine-tipped (see also *Volutaria canariensis*) ..... **CENTAUREA** (G1,4)
- 12' Outer fls pistillate [corolla often narrowly cylindric]; heads sometimes very small, embedded in woolly hairs  
 17. Phyllaries (or outermost bracts of head) papery, membranous, or scarious, sometimes green only in proximal 1/2 or in narrow, central band; heads often embedded in woolly hairs  
 18. Phyllaries 0 or 1–6, not overlapping, < fls; outer receptacle paleate; some or all pistillate fls individually subtended by paleae (which often resemble phyllaries)  
 19. Disk fls bisexual, pappus gen of 13–28+ bristles, ± exserted; inner pistillate fls with pappus  
 20. Receptacle ± cylindric, height 5–15 × diam; most pistillate paleae open to folded around pistillate fls, but not enclosing them, acuminate or bristle-tipped; innermost paleae erect or ascending in fr; outer fr ± = inner ..... **FILAGO**  
 20' Receptacle mushroom-shaped to ovoid, length 0.4–15 × width; most pistillate paleae ± enclosing pistillate fls, obtuse to acute; innermost paleae spreading in fr; outer fr > inner ..... **LOGFIA**
- 19' Disk fls staminate, pappus 0 or 1–12 bristles, incl; pistillate fl pappus 0  
 21. Paleae subtending disk fls (disk paleae) enlarged, rigid, ± spreading, very different from scales subtending pistillate fls (pistillate paleae)  
 22. Disk palea tips strongly incurved to hooked inward, acuminate or abruptly pointed, often spine-like; pistillate paleae closed, strongly 3-veined or middle vein obscure, tips gen strongly scarious-winged; receptacle not bristly, gen widest at tip ..... **ANCISTROCARPHUS**  
 22' Disk palea tips erect or spreading, ± flat to folded, not spine-like, obtuse; pistillate paleae open, concave, veins obscure, tips not or barely scarious-winged; receptacle bristly, widest at base ..... **HESPEREVAX**
- 21' Disk paleae 0 or scales ± gradually reduced, scarious, erect  
 23. Lvs gen opposite; paleae net-veined, inner edge with scarious wing that is hidden in head; pappus 0 ..... **PSILOCARPHUS**  
 23' Lvs alternate or seeming whorled; paleae parallel-veined, scarious wing visible in head; pappus 0 or gen of 1–12 bristles  
 24. Phyllaries 4–6, equal, scarious, obovate, rounded, abruptly different from paleae; style on inner edge of fr; receptacle length ± 1–2 × width ..... **MICROPUS**  
 24' Phyllaries 0 or 1–4, unequal, vestigial or ± like paleae; style ± at fr tip; receptacle length ± 3–8 × width ..... **STYLOCLINE**
- 18' Phyllaries gen many, overlapping, inner often ≥ fls; receptacle epaleate; pistillate fls not subtended by bracts  
 25. Pappus 0 or a minute crown ..... <sup>3</sup>**ARTEMISIA** (G5)  
 25' Pappus of bristles  
 26. Herbage short-appressed-hairy, glandular, or silky; distal 1/2 of outer phyllaries leathery, scarious margin 0 or narrow ..... <sup>2</sup>**PLUCHEA**  
 26' Herbage ± long-hairy (lf gen densely woolly abaxially); phyllaries thin, membranous, margin scarious distal to middle or throughout, gen wide  
 27. Shrub or subshrub; st slender, much-branched ..... **PLECOSTACHYS**  
 27' Herb (if subshrub, st erect or ascending)  
 28. Pl with creeping rhizome ..... <sup>2</sup>**ANAPHALIS** (G6)  
 28' Pl taprooted, fibrous-rooted (sometimes from lfy stolons), or with caudex  
 29. Heads gen in tight groups in gen spike- or narrow, panicle-like cluster (reduced to terminal cluster in small pls); pappus bristles fused at base, falling in ring ..... **GAMOCHAETA**  
 29' Heads in axillary or terminal head-like clusters or in ± open, flat-topped to panicle-like clusters; pappus bristles free or ± fused at base and falling in groups  
 30. Heads in dense, hemispheric to ± spheric terminal cluster closely subtended by involucre-like ring of lfy bracts, sometimes also in head-like axillary clusters ..... **EUCHITON**  
 30' Heads in axillary clusters or terminal clusters, not closely subtended by involucre-like cluster of lfy bracts  
 31. Ann, 1–30 cm, low-growing; sts gen prostrate or spreading; head clusters ± sessile, axillary or terminal; drying mud, shorelines, other moist habitats ..... **GNAPHALIUM**  
 31' Ann to per, 15–200 cm; sts gen erect or ascending, head clusters gen terminal, sessile to stalked, often branched; gen dry habitats ..... **PSEUDOGNAPHALIUM**
- 17' Phyllaries gen green (± purple) throughout, sometimes scarious-margined or inner scarious throughout; heads gen not embedded in woolly hairs  
 32. Pappus well developed  
 33. Pappus of flattened scales or barbed awns  
 34. Lvs gen opposite throughout (occ distal-most alternate)  
 34' Lvs mostly alternate, sometimes very crowded ..... <sup>2</sup>**AMBLYOPAPPUS** (G12,13)  
 35. Pl dotted with sessile resin glands; fr 3–4-angled ..... **EATONELLA** (G13)  
 35' Pl densely woolly; fr compressed  
 36. Lvs entire; pappus scales 2; pl densely tufted; GB .....  
 36' Lvs gen wavy-dentate or shallowly lobed; pappus scales 2–7; pl not densely tufted;  
 s SnJV ..... **Monolopia congonii** (G12,13)

SENECIO (G<sub>6,15</sub>)

- 33' Pappus of bristles  
 37. Main phyllaries in 1 series, equal .....  
 37' Main phyllaries in 2+ series  
 38. Subshrub or shrub  
   39. Sts ± lfless; receptacle paleate; pappus bristles plumose ..... BEBBIA  
   39' Sts evidently lfly; receptacle epaleate; pappus bristles ± smooth to barbed ..... HAZARDIA  
     40. Corolla yellow or becoming ± red-purple; lvs gen ± toothed; pistillate fls 5–18 ..... Pluchea *servicea*  
     40' Corolla pink to deep rose; lvs entire; pistillate fls many .....  
 38' Ann or per  
   41. St thread-like; pistillate fls 1–5 .....  
   41' St stouter; pistillate fls several to many ..... <sup>2</sup>Perityle *emoryi* (G<sub>12,13,14</sub>)  
   42. Pappus bristles 1–2; lf palmately lobed or toothed .....  
   42' Pappus bristles gen many; lf entire to pinnately lobed ..... <sup>2</sup>ERIGERON (G<sub>6,14,15</sub>)  
     43. Head ± flat, button-like .....  
     43' Head gen cylindric, bell-shaped, or ± obconic ..... PLUCHEA  
       44. Disk fl corolla purple; herbage strongly scented; anther bases short-tailed .....  
       44' Disk fl corolla cream or yellow; herbage not strongly scented; anther bases not tailed ..... *Pyrrocoma carthamoides* var. *cusickii*  
       45. Disk corolla 9–13 mm .....  
       45' Disk corolla 3–5 mm ..... <sup>2</sup>ERIGERON (G<sub>6,14,15</sub>)  
       46. Lf not clasping, entire, toothed, or shallowly few-lobed .....  
       46' Lf clasping, regularly dentate or spreading-lobed ..... LAENNEDIA  
 32' Pappus 0 or reduced to a minute crown  
 47. Phyllary margins widely scarious or transparent ..... <sup>3</sup>PENTACHAETA (G<sub>12,14,15</sub>)  
 48. Delicate ann; pistillate corollas thread-like .....  
 48' Per or stout ann; pistillate corollas short, wider than thread-like .....  
 49. Heads in spikes, racemes, or panicles ..... <sup>3</sup>ARTEMISIA (G<sub>5</sub>)  
 49' Heads 1 or few to many in ± flat-topped clusters  
 50. Involucre gen 3–5 mm diam, phyllaries gen 12–20; pappus 0 ..... SPHAEROMERIA  
 50' Involucre 5–22 mm diam, phyllaries gen 30–60; pappus crown-like, 0.1–0.5+ mm ..... TANACETUM (G<sub>12</sub>)  
 47' Phyllary margins gen not scarious or transparent  
 51. Ovary of disk fl much reduced; style tip truncate or tack-shaped  
 52. Lf ovate to widely triangular, gen ± basal or proximal cauline, green adaxially, white abaxially;  
   infl open; corolla white; fr bearing stalked glands ..... ADENOCAULON  
 52' Lf linear to (ob)ovate or ± round, basal and cauline or all cauline, faces ± alike, gen green to gray  
   on 1 or both faces; infl ± dense; corolla ± pale yellow, yellow-white, or ± pink; fr not glandular  
 53. Anthers fused ..... <sup>3</sup>ARTEMISIA (G<sub>5</sub>)  
 53' Anthers ± free or only weakly fused  
 54. Ann; lf 1–2-pinnately divided .....  
 54' Per or subshrub; lf gen entire ..... *Euphorbia nevadensis*  
 51' Ovary of disk fls well developed; style tip ± branched  
 55. Lf wide, palmately lobed or toothed .....  
 55' Lf linear to narrowly oblanceolate, entire or pinnately toothed to lobed ..... <sup>2</sup>Perityle *emoryi* (G<sub>12,13,14</sub>)  
 56. Pl not glandular, not strongly scented  
 57. Lvs opposite .....  
 57' Lvs alternate ..... Lasthenia *microglossa*  
 56' Pl glandular, ± strongly scented ..... <sup>3</sup>PENTACHAETA (G<sub>12,14,15</sub>)  
 58. Pappus present .....  
 58' Pappus 0 ..... <sup>2</sup>AMBLYOPAPPUS (G<sub>12,13</sub>)  
 59. Fr of pistillate fl compressed front-to-back .....  
 59' Fr of pistillate fl compressed side-to-side or ± 3-angled in ×-section ..... HEMIZONELLA (G<sub>10</sub>)  
       MADIA (G<sub>10</sub>)

## Group 3

- Heads discoid; receptacle paleate or bearing tooth-like to membranous scales among fls
1. Lf margins spiny
  2. Heads many-fld.
  - 2'. Heads 1-fld, grouped in spheric 2° head
  - 1' Lf margins not spiny
  3. Pappus of bristles, bristles and small scales, or stout needle-like awns
  4. Pappus of awns
  5. Lf ± lanceolate, simple, or pinnately compound, lflets lanceolate to ovate
  - 5' Lf linear or dissected into linear lobes
  - 4' Pappus of bristles or of bristles and small scales
  6. Corolla purple; fr 1–2 per head; herb.
  - 6' Corolla yellow; fr 18–50 per head; shrub or subshrub
  7. Lf linear to narrowly elliptic or triangular, rough-hairy or becoming glabrous; corolla 6–10 mm;  
   SW, D ..... CRUPINA (G<sub>2</sub>)
- BIDENS (G<sub>2,11</sub>)  
 [Thelesperma megapotamicum]
- SENECIO (G<sub>6,15</sub>)
- [ECHINOPS] (G<sub>5,7</sub>)
- CARTHAMUS (G<sub>4,5</sub>)
- BEBBIA (G<sub>2</sub>)

- 7' Lf ovate to ± round, tomentose; corolla ± 2.5 mm; CCo, SCo ..... **HELICHRYSUM (G6)**
- 3' Pappus 0 or of thin, membranous scales or narrow, scale-like awns ..... *Encelia frutescens*  
8. Ovary and fr strongly flattened, long-ciliate ..... *Geraea viscida*
9. Shrub, strigose ..... *Chaenactis carphoclinia*
- 9' Per, sticky-glandular ..... *Chaenactis carphoclinia*
- 8' Ovary and fr ± thick, not ciliate ..... *Artemisia palmeri*
10. Ann; all or inner phyllaries tapered to long, needle-like tips ..... *EASTWOODIA*
- 10' Bien to shrub; phyllaries obtuse to acute or acuminate ..... *Rudbeckia occidentalis*
11. Lf ± cylindric, lobes many, small ..... *Wyethia invenusta*
- 11' Lf flat, entire to few-lobed ..... [SANTOLINA]
12. Lf deeply and coarsely pinnately 3–7-lobed, abaxially gray-green-canescens ..... *Artemisia palmeri*
- 12' Lf entire or toothed, abaxially glabrous to short-hairy or ± glandular, green ..... *EASTWOODIA*
13. Shrub; lf ± linear or narrowly oblanceolate ..... *Rudbeckia occidentalis*
- 13' Per; lf elliptic to widely ovate or triangular ..... *Wyethia invenusta*
14. Receptacle strongly conic or columnar; corolla dark brown-purple ..... *Rudbeckia occidentalis*
- 14' Receptacle flat to convex; corolla yellow or orange ..... *Wyethia invenusta*

**Group 4**

Heads discoid; receptacle bristly or bearing long, bristle-like scales (free or ± fused at base)

1. Lvs not spiny ..... **ARCTIUM**
2. Phyllaries spine-tipped ..... **CENTAUREA (G1,2)**
3. Phyllary tip-spines hooked ..... **VOLUTARIA (G1)**
- 3' Phyllary tip-spines straight
4. Phyllary tip fringed with spines or slender teeth ..... **CENTAUREA (G1,2)**
- 4' Phyllary tip entire, tapered to spine ..... **VOLUTARIA (G1)**
- 2' Phyllaries not spine-tipped
5. Phyllary tips (at least inner) ± prominently expanded, ± fringed with short spines or irregular teeth ..... **CENTAUREA (G1,2)**
- 5' Phyllary tips not expanded or fringed
6. Proximal lvs linear to oblong or oblanceolate, often lobed or divided; attachment scar of fr lateral ..... **ACROPTILON**
- 6' Proximal lvs lanceolate to triangular, sharply dentate; attachment scar of fr basal ..... **SAUSSUREA (G6)**
- 1' Lvs spiny or spiny-toothed
7. Corolla yellow to orange-red
8. Pappus of many, unequal, narrow scales in several series (sometimes 0), gen 0 on outer frs; fls all fertile; fr 4-angled ..... **CARTHAMUS (G3,5)**
- 8' Pappus of 20 stiff bristles or awns in 2 series, on all frs; outer fls sterile [corolla 3-lobed; ovary vestigial]; fr cylindric, 20-ribbed ..... *Centaurea benedicta (G2)*
- 7' Corolla white to blue, red, or purple
9. Pappus of long-plumose bristles
10. Largest lvs toothed to deeply lobed; involucre body 1–6 cm diam; receptacle gen not fleshy; phyllaries linear to ovate ..... **CIRSIUM**
- 10' Largest lvs often ± compound; involucre body 4–15 cm diam; receptacle fleshy; phyllaries ovate ..... **CYNARA**
- 9' Pappus of ± rough or barbed bristles or slender scales ..... **CARDUUS**
11. St spiny-winged
- 11' St not spiny-winged
12. Lf not blotched along veins; heads not long-peduncled; pappus of many, unequal, narrow scales in several series ..... [*Carthamus leucocaulos*]
- 12' Lf white-blotched along veins; heads long-peduncled; pappus of many long bristles, deciduous in a ring ..... **SILYBUM**

**Group 5**

Heads discoid; receptacle epaleate (or paleae only marginal and simulating phyllaries), not bristly; pappus 0 or reduced to crown

1. Fls 1–7 per head
2. Lvs coarsely 1–2-pinnately lobed, spiny-margined—heads 1-fld, grouped in spheric 2° head ..... **[ECHINOPS] (G3,7)**
- 2' Lvs entire or toothed
3. Shrub; lvs sometimes forming spines
4. Heads in raceme- or panicle-like cluster; 1° lvs soft, entire or distally (2)3(5)-toothed ..... **<sup>3</sup>ARTEMISIA (G2)**
- 4' Heads in ± tight head-like cluster; 1° lvs ± persistent as spines ..... **HECASTOCLEIS (G7)**
5. Heads 1-fld, clustered in 2° heads; phyllaries ± 15 in several overlapping series ..... *Tetradymia comosa*
- 5' Heads 5–6-fld, short-peduncled in terminal clusters; phyllaries 5–6 in 1 series ..... **FLAVERIA (G12)**
6. Herb; lvs never forming spines

- 6' Herbage hairy or glandular ..... *Madia glomerata*
7. Pl densely glandular, soft-hairy to bristly, 5–120 cm ..... *Eriophyllum mohavense*
- 7' Pl not glandular, soft-spreading-hairy to woolly, 1–15 cm ..... <sup>3</sup>*Pentachaeta exilis* subsp. *exilis* (G6)
8. Heads ± sessile; pl 1–2.5 cm, tufted, ± woolly ..... *CARTHAMUS* (G3,4)
- 8' Heads slender-peduncled; pl 2–15 cm, soft-spreading-hairy ..... *Chaenactis artemisiifolia*
- 1' Fls gen 8–many per head — heads not in 2° heads ..... <sup>3</sup>*Pentachaeta exilis* subsp. *exilis* (G6)
9. Lvs with spine-tipped lobes or teeth ..... *PERICOME* (G6)
- 9' Lvs not spiny ..... *PERITYLE* (G6)
10. Fr compressed ..... *PERICOME* (G6)
11. Ann ..... *PERICOME* (G6)
12. Proximal lvs 2–4 × dissected ..... <sup>3</sup>*Pentachaeta exilis* subsp. *exilis* (G6)
- 12' Proximal lvs entire ..... *PERICOME* (G6)
- 11' Per or subshrub ..... *PERICOME* (G6)
13. Phyllaries in 1 series, weakly fused; lvs long-acuminate ..... *PERICOME* (G6)
- 13' Phyllaries in 2–3 series, ± equal, free; lvs not long-acuminate ..... *PERITYLE* (G6)
- 10' Fr not compressed ..... *PERICOME* (G6)
14. Lvs 1–2 × pinnately dissected ..... <sup>3</sup>*ARTEMISIA* (G2)
15. Involucre ovoid to hemispheric, ± enclosing fls; head ± hemispheric; heads many in spike- to panicle-like cluster ..... <sup>3</sup>*ARTEMISIA* (G2)
- 15' Involucre shallowly cup-like or disk-like; head conic to spheric; heads 1–4 in cyme-like cluster ..... *ONCOSIPHON*
16. Mature head spheric; herbage strongly pungent-scented; proximal portion of corolla tube sac-like, enclosing top of ovary ..... *ONCOSIPHON*
- 16' Mature head ovoid; herbage sweetly scented; proximal portion of corolla tube not enclosing top of ovary ..... *MATRICARIA*
- 14' Lvs entire or toothed to shallowly few-lobed ..... *MATRICARIA*
17. Shrub, strongly scented ..... <sup>3</sup>*ARTEMISIA* (G2)
- 17' Herb, not or weakly scented ..... *Lessingia arachnoidea*
18. Corolla pink to lavender ..... *Lessingia arachnoidea*
- 18' Corolla yellow to ± red, red-brown or purple ..... *Eriophyllum pringlei*
19. Pl 50–160 cm — heads spheric, many-fld, long-peduncled, solitary or in open clusters ..... <sup>3</sup>*Pentachaeta exilis* subsp. *exilis* (G6)
- 19' Pl 1–15 cm ..... *Helenium puberulum*
20. Pl densely woolly; heads ± sessile in lfy clusters at branch tips ..... *Eriophyllum pringlei*
- 20' Pl soft-spreading-hairy; heads slender-peduncled ..... <sup>3</sup>*Pentachaeta exilis* subsp. *exilis* (G6)

### Group 6

Heads discoid; receptacle epaleate (or paleae only marginal and simulating phyllaries), not bristly; pappus of bristles

1. Lvs and phyllaries dotted or streaked with embedded, translucent oil glands, otherwise glabrous; pl strongly pungent-scented ..... *POROPHYLLUM*
- 1' Lvs and phyllaries without embedded, translucent oil glands (sometimes stalked- or sessile-glandular, or resin-gland-dotted); pl scented or not ..... *POROPHYLLUM*
2. Shrub or subshrub (if per, pappus of 1–2 bristles + crown of scales) ..... *BACCHARIS* (G2)
3. Corolla white or cream to dull purple or ± green ..... *BRICKELLIA*
4. Ovaries very reduced, sterile; style incl ..... *Ericameria albida*
- 4' Ovaries forming frs; style often exserted ..... *PLEUROCORONIS* (G7)
5. Fr 10-ribbed ..... *AGERATINA*
- 5' Fr 5-ribbed ..... *Hazardia brickelliioides*
6. Lf sessile, narrowly linear, entire ..... *BRICKELLIA*
- 6' Lf sessile or petioled, blade diamond-shaped to lanceolate, elliptic, ovate or triangular, gen toothed ..... *Ericameria albida*
7. Petiole >> lf blade; pappus of bristles and short scales ..... *PLEUROCORONIS* (G7)
- 7' Petiole 0 or gen ≤ blade; pappus of bristles only ..... *AGERATINA*
8. Per or subshrub; lvs serrate, opposite throughout or distal alternate ..... *AGERATINA*
- 8' Shrub — rigidly branched; lvs spiny-toothed, alternate throughout ..... *Hazardia brickelliioides*
- 3' Corolla yellow to orange ..... *AGERATINA*
9. Pappus bristles 1–2 ..... *AGERATINA*
10. Lf blade 3–12 cm, petiole 1.5–5 cm; phyllaries in 1 series, weakly fused ..... <sup>2</sup>*PERICOME* (G5)
- 10' Lf blade gen < 2.5 cm, petiole ≤ 0.6 cm; phyllaries in 2–3 equal series, free ..... <sup>2</sup>*PERICOME* (G5)
- 9' Pappus bristles 18–many ..... *PERICOME* (G5)
11. Involucre hemispheric to ± spheric; phyllaries elliptic or widely ovate ..... *Acamptopappus sphaerocephalus* (G7)
- 11' Involucre gen cylindric to bell-shaped or obconic (hemispheric); phyllaries linear to narrowly ovate ..... *PERICOME* (G5)
12. Phyllaries in 1–2 series, ± equal ..... *PERITYLE* (G6)
13. Phyllaries 9–18; pl glabrous, resinous-glandular; fls 12–21 ..... *PERITYLE* (G6)
- 13' Phyllaries 4–6; pl ± woolly; fls 4–8 ..... *PEUCEPHYLLUM*

- 12' Phyllaries graduated in several series, unequal  
 14. Lvs (at least distal) scale-like  
 15. Heads solitary; fr appressed-hairy .....  
 15' Heads in panicle-like clusters; fr ± glabrous .....  
 14' Lvs linear to oblong, (ob)ovate, or ± round  
 16. Lvs toothed  
 17. Corolla throat expanded gradually above tube .....  
 17' Corolla throat expanded abruptly above tube .....  
 16' Lvs entire  
 18. Phyllaries in 5 ± distinct vertical ranks  
 19. Young st densely tomentose, hairs often tightly matted .....  
 19' Young st glabrous or puberulent .....  
 20. Lvs glandless or glands, if present, not in deep, round pits .....  
 20' Lvs gland-dotted, glands in deep, round pits .....  
 18' Phyllaries not in distinct vertical ranks  
 21. St ± tomentose  
 22. Phyllary tips thin, papery, ascending to ± spreading, creamy white; corolla ± 2.5 mm  
 22' Phyllary margins thick, gen appressed or stiffly ascending, gen green; corolla 5–12.5 mm  
 23. Phyllaries acuminate .....  
 23' Phyllaries obtuse to acute  
 24. St loosely tomentose; pappus 3–5 mm .....  
 24' St closely tomentose exc glabrous ribs; pappus 8–11 mm .....  
 21' St glabrous or ± hairy but not tomentose  
 25. Corolla throat expanded abruptly above tube .....  
 25' Corolla throat expanded gradually above tube .....  
 26. Lvs gland-dotted in deep, round pits .....  
 26' Lvs glandless or glands, if present, not in deep, round pits .....  
 27. Involucre 5–10 mm .....  
 27' Involucre 10–17.5 mm .....  
 28. Lvs 30–85 mm, ± lanceolate; fr glabrous; s W&I, n DMtns .....  
 28' Lvs 5–15 mm, linear; fr appressed-hairy; s KR, n NCoRH .....  
 2' Herb  
 29. Corollas white to maroon or purple .....  
 30. Lvs and phyllaries spiny .....  
 30' Lvs and phyllaries not spiny .....  
 31. Pappus bristles 2–6 .....  
 32. Lvs oblong to ovate, toothed; involucre widely bell-shaped to hemispheric; wet places, GV, SCo .....  
 32' Lvs linear, gen entire; involucre cylindric to narrowly bell-shaped .....  
 33. Corolla 5–6 mm; DSon .....  
 33' Corolla 2–3 mm; NCoR, SNF, GV, CW .....  
 31' Pappus bristles gen >> 6 .....  
 34. Phyllaries ± equal, in 1–2 series .....  
 35. Fls 10–many; per; pappus bristles simple .....  
 35' Fls 2(3); ann; pappus bristles plumose .....  
 34' Phyllaries unequal, graduated in several series .....  
 36. Ann; outer corollas often bilateral, ± ray-like .....  
 36' Per; corollas all radial .....  
 37. Herbage glabrous, sticky .....  
 37' Herbage puberulent to tomentose .....  
 38. Lvs entire; involucre 3–9 mm; fls unisexual — pls dioecious .....  
 38' Lvs sharply toothed; involucre 10–15 mm; fls bisexual .....  
 39. Corollas cream, lobes ± deltate; style branches long, club-shaped .....  
 39' Corollas white to gen ± purple, lobes linear; style branches short, oblong .....  
 29' Corollas yellow to orange or red .....  
 40. Phyllaries in 2–several series, unequal, often strongly graduated .....  
 41. Phyllaries thin-membranous, white to pink or red .....  
 42. St from rhizome; lf rosette withered at fl; cauline lvs long, all exc distal-most ± equal .....  
 42' St from persistent lf rosette or thick, often branched caudex; cauline lvs gen ± reduced, at least distal-most short, 1–3 cm .....  
 41' Phyllaries not thin-membranous, not white .....  
 43. Pl low, mounded, densely gray-woolly, strongly scented; lvs often wider than long; phyllaries in 2 series, outer phyllaries wide, tips spreading .....  
 Arida carnosa  
*Lepidospartum squamatum*  
**HAZARDIA** (G15)  
**ISOCOMA**  
**ERICAMERIA** (G15)  
**CHRYSOTHAMNUS**  
**ERICAMERIA** (G15)  
**HELICHRYSUM** (G3)  
**ERICAMERIA** (G15)  
*Isocoma menziesii*  
*Lepidospartum latisquamum*  
**ISOCOMA**  
**ERICAMERIA** (G15)  
**CHRYSOTHAMNUS**  
**CUNICULOTINUS**  
*Ericameria ophitidis*  
**ONOPORDUM**  
**TRICHOCORONIS**  
**MALPERIA** (G7)  
*Pentachaeta exilis* subsp. *exilis* (G5)  
**AGERATINA**  
**DIMERESIA**  
**LESSINGIA** (G1)  
*Baccharis glutinosa*  
**ANTENNARIA**  
**BRICKELLIA**  
*Saussurea* (G4)  
**ANAPHALIS** (G2)  
**ANTENNARIA** (G2)  
**PSATHYROTES**

- 43' Pl spreading to erect, gen not densely woolly, scented or not; lvs gen longer than wide; phyllaries in 3-several series ..... *GRINDELIA* (G<sub>7,13,15</sub>)
44. Pappus bristles flat, readily deciduous; involucre gummy ..... *Dieteria canescens* var. *shastensis*
- 44' Pappus bristles ± cylindric, ± persistent; involucre gen not gummy ..... *Pentachaeta exilis* (G<sub>5</sub>)
45. Ann ..... *Lessingia* (G<sub>1</sub>)
46. Outer-fl corollas ± bilateral, often enlarged, ± ray-like ..... *Brickellia grandiflora*
- 46' Outer-fl corollas radial ..... *Dieteria canescens* var. *shastensis*
47. Pl 10–50 cm; phyllaries gen in 3–5 series ..... *Pentachaeta exilis* (G<sub>5</sub>)
- 47' Pl 2–6 cm; phyllaries in 2–3 series ..... *ERIGERON* (G<sub>2,14,15</sub>)
- 45' Per — outer-fl corollas radial, not enlarged ..... *EUCEPHALUS* (G<sub>14</sub>)
48. Phyllary tips spreading ..... *Heterotheca oregona*
49. Lvs lanceolate to triangular; corollas creamy yellow ..... *Anisocarpus scabridus* (G<sub>7</sub>)
- 49' Lvs linear to ± obovate; corollas bright yellow ..... *CARLQUISTIA* (G<sub>7</sub>)
- 48' Phyllary tips gen appressed (lowest sometimes spreading) ..... *RAILLARDELLA* (G<sub>7,10</sub>)
50. Lvs linear to narrowly oblong; disk wide, button-like ..... *ARNICA* (G<sub>15</sub>)
- 50' Lvs linear to ovate; disk ± narrow ..... *PERICOME* (G<sub>5</sub>)
51. Hairs smooth; various habitats ..... *ARNICA* (G<sub>15</sub>)
- 51' Hairs minutely knobby (at 20×); gen dry streambanks, gravel bars ..... *SENECIO* (G<sub>2,15</sub>)
- 40' Phyllaries in 1–2 series, ± equal ..... *RAILLARDELLA* (G<sub>7,10</sub>)
52. Pappus bristles ± plumose ..... *ARNICA* (G<sub>15</sub>)
53. Lvs all or mostly basal ..... *ANISOCARPUS* (G<sub>7</sub>)
- 53' Some or all lvs cauline ..... *ARNICA* (G<sub>15</sub>)
54. Phyllaries in 2 series; pappus bristles ± plumose ..... *ANISOCARPUS* (G<sub>7</sub>)
- 54' Phyllaries or phyllary-like paleae in 1 series; pappus bristles plumose ..... *CARLQUISTIA* (G<sub>7</sub>)
55. Glandless hairs restricted to margins of phyllary-like paleae ..... *PERICOME* (G<sub>5</sub>)
- 55' Glandless hairs not restricted to margins of phyllary-like paleae ..... *PERICOME* (G<sub>5</sub>)
- 52' Pappus bristles smooth or barbed ..... *SENECIO* (G<sub>2,15</sub>)
56. Cauline lvs opposite (distal-most sometimes alternate) ..... *SENECIO* (G<sub>2,15</sub>)
57. Pappus bristles many; phyllaries in 2 series, free ..... *ARNICA* (G<sub>15</sub>)
- 57' Pappus bristles 1–2; phyllaries in 1 series, fused at base ..... *PSATHYROTES*
- 56' Cauline lvs alternate ..... *PSATHYROTES*
58. Ann or short-lived per with slender taproot ..... *TRICHOPTILUM* (G<sub>1</sub>)
59. Main phyllaries in 1 series, outer, if present, << inner ..... *SENECIO* (G<sub>2,15</sub>)
- 59' Main phyllaries in 1–2 series, ± equal ..... *SENECIO* (G<sub>2,15</sub>)
60. Lf thread-like to linear ..... *SENECIO* (G<sub>2,15</sub>)
- 60' Lf oblanceolate to ovate or wider ..... *Pentachaeta exilis* subsp. *exilis* (G<sub>5</sub>)
61. Pappus bristles ± free; heads short-peduncled; lvs entire or blunt-toothed ..... *PSATHYROTES*
- 61' Pappus bristles fused at base in 5 groups; heads long-peduncled; lvs sharply toothed or lobed ..... *TRICHOPTILUM* (G<sub>1</sub>)
- 58' Per, often with caudex or rhizome ..... *CACALIOPSIS*
62. Lvs palmately veined and lobed ..... *DELAIREA*
63. Pl ± erect ..... *LUINA*
- 63' Pl a twining vine ..... *PACKERA* (G<sub>2,15</sub>)
- 62' Lvs pinnately veined (or lateral veins obscure), entire to pinnately lobed ..... *ERIGERON* (G<sub>2,14,15</sub>)
64. Pappus double, outer pappus of minute bristles or scales ..... *ERIGERON* (G<sub>2,14,15</sub>)
- 64' Pappus single (double, bristles ± equal) ..... *ERIGERON* (G<sub>2,14,15</sub>)
65. Lvs densely white-tomentose abaxially; corollas creamy yellow ..... *ERIGERON* (G<sub>2,14,15</sub>)
- 65' Lvs glabrous to loosely tomentose abaxially; corollas yellow ..... *ERIGERON* (G<sub>2,14,15</sub>)
66. Distal lf blades 1.5–4 cm; phyllary tips green or red ..... *ERIGERON* (G<sub>2,14,15</sub>)
- 66' Distal lf blades 6–25 cm; phyllary tips black or green ..... *SENECIO* (G<sub>2,15</sub>)

## Group 7

- Heads discoid; receptacle epaleate (or paleae only marginal and simulating phyllaries), not bristly; pappus of scales or awns
1. Heads ± sessile, sometimes in dense 2° clusters ..... *ECHINOPS* (G<sub>3,5</sub>)
  2. Heads 1-fld, in dense 2° heads; pl ± spiny ..... *HECASTOCLEIS* (G<sub>5</sub>)
  3. Herb, 10–20 dm, stout, erect; lvs large, 1–2-pinnately lobed, spiny-margined; 2° heads spheric  
3' Shrub, 4–7 dm; lvs small, spine-tipped, margins weakly spiny; 2° heads not spheric, ± concealed by  
veiny bracts ..... *ERIOPHYLLUM* (G<sub>12,13</sub>)
  - 2' Heads 3–20-fld, solitary or clustered; pl not spiny ..... *OBOCHAENACTIS*
  4. Lf tips gen 3-lobed; pappus not falling in a ring ..... *ERIOPHYLLUM* (G<sub>12,13</sub>)
  - 4' Lf tips entire; pappus falling in a ring ..... *OBOCHAENACTIS*

- 1' Heads peduncled  
 5. Phyllaries unequal, graduated in 2-many series, outer << inner  
 6. Pappus of short scales alternating with longer awns or bristles  
 7. Ann; lvs linear, gen entire .....  
 7' Per or subshrub; lvs lanceolate to ± diamond-shaped, gen few-toothed ..... **MALPERIA** (G6)  
 6' Pappus of readily deciduous awns or narrow, bristle-like scales, or of scales that are ± dissected into bristles ..... **PLEUROCORONIS** (G6)  
 8. Shrub; phyllary tips appressed .....  
 8' Herb; phyllary tips often spreading to recurved ..... *Acamptopappus sphaerocephalus* (G6)  
 9. Involucre gummy; pappus awns readily deciduous .....  
 9' Involucre hairy or glandular; pappus scales often ± dissected into bristles ..... **GRINDELIA** (G6,13,15)  
 5' Phyllaries or phyllary-like paleae ± equal (or outer > inner), in 1-3 series ..... **LESSINGIA** (G1,6)  
 10. Head ± spheric; lvs decurrent .....  
 10' Head cylindric to hemispheric; lvs not decurrent ..... **HELENIUM** (G12,13)  
 11. Phyllary margins ± scarious, white to yellow, red, or purple .....  
 12. Pappus scales bristle-tipped; corollas cream to white or purple-tinged .....  
 12' Pappus scales obtuse to acute; corollas gen yellow ..... **HYMENOTHRIX** (G1)  
 13. Ann; pappus scales gen 8 .....  
 13' Per; pappus scales 12-22 ..... **BAHIA**  
 11' Phyllary or phyllary-like palea margins not evidently scarious, gen ± green ..... **HYMENOPAPPUS**  
 14. Corollas white to purple .....  
 15. Fr 3-9 mm; pappus scale midrib 0; lvs often toothed or lobed .....  
 15' Fr 10-15 mm; pappus scale midrib well developed; lvs entire ..... **CHAENACTIS** (G1)  
 14' Corollas yellow ..... **PALAFOXIA** (G1)  
 16. Outer corollas ± bilateral, much enlarged, ray-like; pappus scales entire or toothed ..... *Chaenactis glabriuscula*  
 16' Outer corollas gen radial, not or only slightly enlarged; pappus scales plumose or dissected into bristles .....  
 17. Ann or short-lived per; rhizome 0 .....  
 18. Lf teeth and lobes blunt; involucre densely glandular; pappus scales plumose ..... *Layia discoidea*  
 18' Lf teeth and lobes sharp; involucre not glandular; pappus scales dissected into bristles .....  
**TRICHOPTILIUM** (G1,6)  
 17' Per with rhizome .....  
 19. Lvs mostly or all basal ..... **RAILLARDELLA** (G6,10)  
 19' Lvs basal and cauline, well distributed on st .....  
 20. Glandless hairs restricted to margins of phyllary-like paleae ..... *Anisocarpus scabridus* (G6)  
 20' Glandless hairs not restricted to margins of phyllary-like paleae ..... **CARLQUISTIA** (G6)

### Group 8

Heads liguliflorous; all fls of head with petal-like, 5-lobed ligules; corollas gen readily withering; sap gen milky

1. Receptacle with long paleae among fls  
 2. Lvs mostly cauline, spiny, thistle-like; paleae wide, individually enclosing and falling with frs ..... **SCOLYMUS**  
 2' Lvs mostly or all basal, not spiny; paleae narrow, membranous, not enclosing frs .....  
**HYPOTCHAERIS**  
 3. Peduncle bracted; scape branched or unbranched .....  
 3' Peduncle bractless; scape unbranched .....  
 4. Pappus bristles not longer on 1 side of frs, ± minutely barbed; phyllary margins not wide and papery ..... <sup>2</sup>**AGOSERIS**  
 4' Pappus bristles much longer on 1 side of all frs, plumose; phyllary margins papery, much wider than midrib ..... <sup>2</sup>**ANISOCOMA**  
 1' Receptacle epaleate (sometimes bristly or minutely scaly)  
 5. Pappus 0 (or occ low crown in *Phalacroseris*) ..... **PHALACROSERIS**  
 6. Heads solitary; st lfless .....  
 6' Heads few to many in cyme-like or panicle-like infl; st often lfy ..... **RHAGADIOLUS**  
 7. Outer frs 10-15 mm, rigidly spreading, individually enfolded by inner phyllaries .....  
 7' Outer fr 3-5 mm, gen straight (curved), not individually enfolded by phyllaries ..... **ATRICHOSERIS**  
 8. Lvs mostly basal; corolla white; D .....  
 8' Lvs mostly cauline; corolla yellow; NW, SN, GV, CCo, SnFrB, SW ..... **LAPSANA**  
 5' Pappus present .....  
 9. Corolla blue .....  
 10. Pappus of short scales .....  
 10' Pappus of long bristles .....  
 9' Corolla yellow or white to purple .....  
 11. Pappus of scales, stiff awns (sometimes with shorter bristles), or awn-tipped scales, not plumose (exc *Microseris nutans*, *Microseris sylvatica*, inner fr pappus of *Leontodon*) .....  
 12. Outer frs often enfolded by phyllaries; pappus of outer and inner frs dissimilar .....  
 13. Lvs basal and cauline; peduncle thickened below fr head; inner fr pappus bristles minutely barbed ..... **HEDYPNOIS**

- 13' Lvs basal; peduncle not or scarcely thickened; inner fr pappus bristles plumose ..... <sup>3</sup>**LEONTODON**
- 12' Outer frs gen not enfolded by phyllaries; pappus of outer and inner frs ± alike ..... **CHAETADELPHIA**
14. Corolla pink to ± white; st much-branched — cauline lvs short, linear, entire ..... **TOLPIS**
- 14' Corolla white to yellow or orange; st branches 0–few
15. Outer phyllaries long, linear; pappus scales stiff, bristle-like ..... **NOTOCALAIS troximoides**
- 15' Outer phyllaries ≤ inner, gen wider than linear (if linear, short); pappus scales few to many, bristle-tipped
16. Per, scapose; rosette lvs entire, narrow, long-tapered; heads erect; pappus scales 10–30, narrowly lanceolate, silvery, bristle-tip not plumose ..... **NOTOCALAIS troximoides**
- 16' Ann or per, scapose or not; lvs entire to lobed; pappus scales 1–many, silvery to ± black, bristle-tip smooth, barbed, or plumose
17. Ann; head erect; involucre glabrous, outer phyllaries not < 1/4 inner; pappus scales 5, lanceolate, silvery, bristle short, smooth, from evenly notched scale tip ..... **UROAPPUS**
- 17' Ann or per; head ± nodding in bud; involucre glabrous to hairy, outer phyllaries often < 1/4 inner; pappus scales 1–30, variously colored, tip entire to unevenly cut, bristle from tip smooth to plumose
18. Per with fleshy taproot(s); ligules >> involucre; pappus scales 5–30 ..... <sup>3</sup>**MICROSERIS**
- 18' Ann; ligules ± = involucre; pappus scales 5 (often < 5 in *Microseris douglasii*)
19. Head gen strongly nodding in bud; pappus scales gen deltate to ovate (if lanceolate, tapered to bristle); lvs basal ..... <sup>3</sup>**MICROSERIS**
- 19' Head gen not strongly nodding in bud; pappus scales narrowly lanceolate, tip notched or irregularly cut; cauline lvs sometimes present ..... **STEBBINSOSERIS**
- 11' Pappus of simple bristles or of ± plumose bristles or awns
20. Pappus bristles or awns plumose
21. Pappus bristles wide at base, scale-like ..... <sup>3</sup>**MICROSERIS**
- 21' Pappus of bristle or awns, slender or thick at base, not scale-like
22. Pappus bristles very unequal
23. Pappus bristles much longer on 1 side of all frs; phyllary margins papery, much wider than midrib ..... <sup>2</sup>**ANISOCOMA**
- 23' Outer fr pappus of short scales, inner fr pappus of long and short bristles; phyllary margins not wide and papery ..... <sup>3</sup>**LEONTODON**
- 22' Pappus bristles ± equal
24. Lvs linear to lanceolate or ovate-elliptic, grass-like, entire or few-toothed; involucre 2.5–5 cm
25. Per; phyllary series several; fr beak 0 ..... **SCORZONERA**
- 25' Ann or bien; phyllary series 1; fr beak > body ..... **TRAGOPOGON**
- 24' Lvs lanceolate to elliptic (or scale-like), larger lvs ± toothed or lobed; involucre 0.5–2 cm
26. Corollas white to pink or lavender
27. Fr beaked; corollas white or cream, sometimes red-veined ..... **RAFINESQUIA**
- 27' Fr beak 0; corollas pink to pale lavender ..... **STEPHANOMERIA**
- 26' Corollas yellow
28. Lvs in basal rosette; heads gen 1 on scapose peduncle — outer phyllaries inconspicuous ..... <sup>3</sup>**LEONTODON**
- 28' Lvs basal and cauline, or basal 0 at fl; heads 1–many, not on scapose peduncle
29. Phyllaries in 2 series, outer wide, free, inner narrow ..... **HELMINTHOTHECA**
- 29' Phyllaries in 1 series, wide, bases slightly fused ..... **UROSPERMUM**
- 20' Pappus bristles smooth or barbed, stiff or soft
30. Fr ± compressed
31. Fr beaked (beak sometimes short, thick) ..... <sup>2</sup>**LACTUCA**
- 31' Fr beak 0 ..... **SONCHUS**
- 30' Fr not compressed
32. St much-branched
33. St thorny; corollas pink or lavender to red-purple (white) ..... **PLEIACANTHUS**
- 33' St not thorny; corollas yellow or white to light pink ..... **PRENANTHELLA**
34. Fls 3–4 per head, corollas white or light pink; ann, 5–30 cm
- 34' Fls 6–60 per head, corollas white or yellow; bien or per, 10–150 cm
35. Fr beaked ..... **CHONDRILLA**
- 35' Fr beak 0 ..... **HIERACIUM**
- 32' St little-branched, not thorny; corolla yellow, white, lavender, or rosy to ± purple ..... **MUNZOTHAMNUS**
36. Shrub; s Chi (San Clemente Island)
- 36' Herb
37. Fr widely cylindric or base ± narrowed, not beaked
38. Some or all pappus bristles falling from fr — long glandless hairs 0 ..... <sup>2</sup>**MALACOTHRIX**
- 38' Pappus bristles persistent
39. Pl long-hairy, esp below; heads few to many; st gen branched
- 39' Pl glabrous or minutely puberulent; heads solitary on scapose peduncle ..... <sup>2</sup>**HIERACIUM**
40. Ann; pappus bristle 5 or fewer ..... *Microseris douglasii*

- 40' Per; pappus bristles > 20  
 41. Pappus bristles ± brown, barbed .....  
 41' Pappus bristles white, smooth .....  
 37' Fr tapered at both ends (or distally), often beaked ..... *Microseris borealis*  
 42. Pappus bristles deciduous, sometimes a few persistent ..... <sup>2</sup>*Nothocalais alpestris*  
 43. Fr not beaked .....  
 43' Fr short-beaked ..... <sup>2</sup>**MALACOTHRIX**  
 44. Fr tapered to beak; lf margins not hard .....  
 44' Fr abruptly beaked; lf margins white, hard ..... **CALYCOSERIS**  
 45' Pappus bristles persistent ..... **GLYPTOLEURA**  
 45. St branched, lfy (lvs often reduced); beak present or 0 .....  
 45' St unbranched, lfless (exc some ann *Agoseris*) ..... **CREPIS**  
 46. Phyllaries unequal, outer << inner, inner equal; fr beak long, slender .....  
 46' Phyllaries equal or ± graduated in several series; fr beak 0 or short to long, slender to stout ..... **TARAXACUM**  
 47. Pl gen ± hairy; outer phyllaries gen < inner, often striped ± purple, speckled or not ..... <sup>2</sup>**AGOSERIS**  
 47' Pl ± glabrous (or petioles ciliate); outer phyllaries ± = inner, finely speckled purple —  
 KR, n&c SNH ..... <sup>2</sup>*Nothocalais alpestris*

**Group 9**

All fls of head with 2-lipped corollas

1. Per; corolla white to pink-purple; SCoR, SW ..... **ACOURTIA**  
 1' Shrub; corolla yellow; D ..... **TRIXIS**

**Group 10**Heads radiate; phyllaries in 1(2) series, individually subtending ray fls;  
receptacle paleate (at least between ray and disk fls)

1. Phyllary margins ± flat, not clasping or enclosing ray ovaries  
 2. Pappus 2–4 mm, of plumose bristles ..... *Layia hieracioides*  
 2' Pappus 0 or < 1 mm, of scales or awns  
 3. Lvs woolly; ray corollas thin, deciduous; receptacle center with 1–6 palea-like scales ..... *Eriophyllum ambiguum* var. *paleaceum*  
 3' Lvs scabrous; ray corollas leathery, persistent; receptacle paleate throughout, paleae awn-tipped ..... **SANVITALIA**  
 1' Phyllary margins folded, ± clasping or enclosing ray ovaries  
 4. Mature ray fr compressed front-to-back, adaxial face gen ± covered by phyllary margins ..... **HEMIZONELLA** (G2)  
 5. Disk fls 1(2); ann 1–20 cm .....  
 5' Disk fls 3–120+; ann or per 2–150 cm ..... **HOLOZONIA**  
 6. Per, rhizomed; disk corolla white .....  
 6' Ann; disk corolla yellow (sometimes aging ± red)  
 7. Pappus of 10 obtuse scales, 3–13 mm; fr 10-ribbed ..... **ACHYRACHAENA**  
 7' Pappus 0 or of awns, bristles, or acute scales, 0.5–7 mm; fr not ribbed ..... **LAGOPHYLLA**  
 8. Ray fls 5; disk fls 6, staminate; pappus 0 .....  
 8' Ray fls 3–27; disk fls 5–125, bisexual; pappus of (0)1–32 awns, bristles, or scales ..... **LAYIA**  
 4' Mature ray fr compressed side-to-side or ± 3-angled or round in ×-section, adaxial face covered by  
phyllary margins or not ..... **BLEPHARIPAPPUS**  
 9. Disk fl style bristly-puberulent proximal to minutely notched tip .....  
 9' Disk fl style glabrous proximal to tapered branches .....  
 10. Per; lvs all or mostly basal, caudine 0 or proximal, few; disk pappus of narrowly awl-shaped or ±  
bristle-like, ciliate-plumose scales ..... **RAILLARDELLA** (G6,7)  
 10' Ann, lf-stemmed per, or subshrub to shrub; disk pappus 0 or of scales, often not awl-shaped or  
bristle-like and ciliate-plumose .....  
 11. Distal lvs and peduncle bracts gen spine-tipped; disk fls staminate, most or all subtended by paleae ..... **CENTROMADIA**  
 11' Distal lvs and peduncle bracts not spine-tipped; disk fls bisexual or staminate, outermost to all  
subtended by paleae .....  
 12. Rays yellow, sometimes proximally ± red; ray fr gen compressed side-to-side or ± 3-angled in  
×-section, abaxially rounded, adaxially ± 2-faced, angle between adaxial faces 15–70°; peduncle  
bracts not tipped by pit- or tack-gland ..... **MADIA** (G2)  
 13. Disk pappus 0 .....  
 13' Disk pappus 0 .....  
 14. Per .....  
 15. Anthers yellow to ± brown; ray fr short-beaked; involucre bell-shaped, ellipsoid, or spheric ..... **ANISOCARPUS**  
 15' Anthers ± dark purple; ray fr beak 0; involucre bell-shaped to hemispheric ..... **KYHOSIA**

- 14' Ann  
 16. Anthers ± yellow to ± brown .....  
 16' Anthers ± dark purple .....  
 12' Rays yellow, white, or rose; ray fr round in x-section or nearly so (exc ± flattened adaxially) or ± 3-angled [abaxially gen ± widely 2-faced, angle between those faces gen 90°, adaxially gen ± flattened to slightly bulging]; peduncle bracts sometimes tipped by pit- or tack-gland .....  
 17. Ray fr ± completely enfolded by a phyllary; rays yellow, sometimes ± red at base .....  
 18. Disk pappus of fringed or plumose scales .....  
 18' Disk pappus 0 .....  
 17' Ray fr gen partly enfolded by a phyllary, adaxial face exposed; rays yellow, white, or rose .....  
 19. Ann; lvs ± linear, gen narrowly so; ray corolla lobed (1/4)1/3–3/4+ length, lobes often spreading; peduncle bracts gen tack-gland-tipped (exc in *Osmadenia*, ray lobes widely spreading); disk fr not strongly ribbed .....  
 20. Ray fr beak 0; tack glands present .....  
 20' Ray fr short-beaked; tack glands 0 .....  
 19' Ann or subshrub to shrub; lvs linear or wider; ray corolla lobed gen 1/10–1/2 length, lobes ± parallel; peduncle bracts not tack-gland-tipped unless frs 10-ribbed .....  
 21. Ray gen white or yellow, often abaxially red- or purple-veined; ray fr beak 0 or inconspicuous, straight .....  
 22. Paleae restricted to outermost disk fls; disk fls bisexual; ray fr hairy .....  
 22' Paleae throughout receptacle, subtending all disk fls; disk fls staminate; ray fr glabrous .....  
 21' Ray yellow, not abaxially purple-veined; ray fr beak adaxial, ascending .....  
 23. Ann or subshrub to shrub; peduncle bracts not pit-gland-tipped; if ann, paleae subtending only outermost disk fls .....  
 23' Ann; peduncle bracts pit-gland-tipped; paleae throughout receptacle, subtending all or most disk fls .....  
CALYCADENIA  
OSMADENIA  
BLEPHARIZONIA  
HEMIZONIA  
DEINANDRA  
HOLOCARPHA

### Group 11

Heads radiate; phyllary series 2 or more, none or only some individually subtending ray fls; receptacle paleate, gen ± throughout (only between ray and disk fls in *Rigiopappus*)

1. Rays white to pink or purple  
 2. Disk corollas white or pink  
 3. Lvs finely dissected, aromatic; heads many in flat-topped clusters; rays ovate to round .....  
 3' Lvs entire or toothed, not aromatic; heads solitary or in small cymes; rays narrowly linear .....  
 2' Disk corollas yellow  
 4. Lvs entire or toothed  
 5. Lvs opposite, ± ovate .....  
 5' Lvs alternate, linear or lance-linear to narrowly oblanceolate .....  
 4' Lvs pinnately lobed or dissected to compound  
 6. Phyllaries in 2 very different series [inner ± membranous]  
 7. Lvs pinnate; lflets flat, serrate; rays short, inconspicuous .....  
 7' Lvs 1–3-pinnately dissected, segments narrowly linear, entire; rays long, conspicuous .....  
 6' Phyllaries graduated in 2–several series, unequal, margins scarios or transparent  
 8. Fr initially hairy, densely tomentose in age .....  
 8' Fr glabrous  
 9. Base of corolla narrow .....  
 9' Base of corolla wide, enclosing fr tip .....  
 1' Rays yellow to orange (sometimes multi-colored)  
 10. Paleae flat, linear to ovate, not folded around disk ovaries  
 11. Phyllaries ± alike, in 2+ series  
 12. Phyllaries graduated in several series, unequal, margins scarios or transparent — pappus crown-like, gen 0.2–0.3 mm .....  
 12' Phyllaries not strongly graduated, ± equal, margins not scarios or transparent (exc inner phyllaries of *Rigiopappus*)  
 13. Lvs oblong to ovate, entire to pinnately lobed; pappus scales awn-tipped .....  
 13' Lvs linear, entire; pappus scales stiff, tapered .....  
 11' Phyllaries in 2 very different series, outer with lf-like texture, inner ± membranous .....  
 14. Pappus of awns with reflexed barbs .....  
 14' Pappus 0 or of flat scales  
 15. Lvs alternate or all basal; ray fls fertile .....  
 15' Lvs opposite; ray fls sterile .....  
 16. Inner phyllaries free or fused in proximal 1/10 .....  
 16' Inner phyllaries fused in proximal 1/5–1/3 .....  
ACHILLEA  
ECLIPTA  
GALINSOGA  
2RIGIOPAPPUS (G12,13)  
BIDENS pilosa  
COSMOS  
LASIOSPERMUM  
ANTHEMIS  
CHAMAEMELUM  
[COTA]  
[GAILLARDIA] (G13)  
2RIGIOPAPPUS (G12,13)  
BIDENS (G2,3)  
LEPTOSYNE  
COREOPSIS  
*Thelesperma simplicifolium* var. *simplicifolium*

- 10' Paleae each folded around a disk fl ovary  
 17. Ray fls fruiting [style present, ovary well developed]  
 18. Ann; disk fr compressed, winged ..... *Verbesina encelioides* subsp. *exauriculata*  
 18' Per; disk fr gen 4-angled  
 19. Lvs mostly ± basal, cauline 0 or few; pappus 0 ..... *BALSAMORHIZA*  
 19' Lvs basal and cauline; pappus of scales or 0 ..... *WYETHIA*  
 17' Ray fls sterile [ovary vestigial, style gen 0]  
 20. Fr strongly compressed, margin ± thin  
 21. Fr margin ciliate  
 22. Subshrub or shrub ..... *ENCELIA*  
 22' Ann or per (sometimes with woody caudex)  
 23. Lvs all ± basal, gray or silvery, entire ..... <sup>2</sup>*ENCELIOPSIS*  
 23' Lvs mostly cauline, green, entire or toothed ..... *Geraea canescens*  
 21' Fr margin not ciliate  
 24. Lvs all ± basal, silvery or gray; fr margin corky ..... <sup>2</sup>*ENCELIOPSIS*  
 24' Lvs basal and cauline or all cauline, green; fr margin thin or winged  
 25. Per; lvs basal and cauline, entire ..... *HELIANTHELLA*  
 25' Subshrub; lvs cauline, some often toothed ..... *Verbesina dissita*  
 20' Fr weakly compressed or not, margin gen not thin  
 26. Receptacle widely cylindric to conic gen ± spheric; disk corollas yellow-green or dark brown-purple  
 27. Involucre at early fl 8–16 mm diam; fr compressed, ciliate abaxially — phyllary series unequal, outer >> inner ..... *RATIBIDA*  
 27' Involucre at early fl 15–30+ mm diam; fr not compressed, not ciliate abaxially ..... *RUDBECKIA*  
 26' Receptacle gen flat to convex, if conic, disk corollas yellow or yellow-orange  
 28. Pappus 0 ..... *HELIOMERIS*  
 28' Pappus present  
 29. Herb (subshrub); pappus scales gen readily deciduous ..... *HELIANTHUS*  
 29' Subshrub or shrub; pappus scales persistent or readily deciduous (if subshrub, pappus persistent)  
 30. Lf oblong or narrowly lanceolate to ovate or triangular, base obtuse or rounded to truncate or cordate ..... *BAHIOPSIS*  
 30' Lf elliptic to widely obovate, base tapered, wedge-shaped ..... *VIGUIERA*

### Group 12

Heads radiate; receptacle epaleate; pappus 0 or a low crown

1. Lvs opposite, at least proximally  
 2. Distal lvs opposite  
 3. Phyllaries in 3+ series, widely overlapping; per, fleshy, coastal ..... *JAUMEA*  
 3' Phyllaries in 1–2 series, barely overlapping; ann or per, gen not fleshy, coastal or interior  
 4. Pl white-hairy and sessile-glandular; old ray corolla papery, persistent on fr when dry; disk fls staminate ..... *Arnica dealbata*  
 4' Pl glabrous or ± hairy; old ray corolla deciduous from fr; disk fls gen fruiting ..... *FLAVERIA* (G5)  
 5. Ray fl gen 1 per head; ray < 1 mm ..... *LASTHENIA* (G2,13)  
 5' Ray fls 4–many; ray gen >> 1 mm  
 6. Lf margin without embedded oil glands, base not bristly-ciliate; herbage gen not scented; spring-fl. ..... *PECTIS* (G13,15)  
 6' Lf margin with embedded oil glands, base bristly-ciliate; herbage strongly scented; summer/fall-fl ..... *Eriophyllum wallacei*  
 2' Distal lvs alternate  
 7. Ray white  
 8. Ray not red-veined abaxially; e SnFrB, SnGb, SnBr, PR, SNE, D ..... *Syntrichopappus lemontii*  
 8' Ray red-veined abaxially; SCoRI, TR, SnJt ..... *MONOLOPIA*  
 9. Ray yellow  
 9' Ray corolla with small lobe opposite ray ..... *AMBLYOPAPPUS* (G2,13)  
 10. Ray corolla without small lobe opposite ray ..... *ERIOPHYLLUM* (G7,13)  
 10' Lvs mostly or all opposite.  
 11. Lvs glabrous ..... *Artemisia bigelovii*  
 11' Lvs ± tomentose .....  
 12. Ray ≤ 1 mm ..... *TANACETUM* (G2)  
 13. Shrub .....  
 13. Herb .....  
 14. Lf finely dissected; phyllaries unequal, overlapping in several series, scarious-margined ..... <sup>2</sup>*TANACETUM* (G2)

- in *Pentachaeta*) ..... <sup>2</sup>**PENTACHAETA** (G<sub>2,14,15</sub>)
15. Phyllaries in 2–3 series; lvs linear, entire ..... <sup>2</sup>**AMBLYOPAPPUS** (G<sub>2,13</sub>)
- 15' Phyllaries in 1 series; proximal lvs often toothed or lobed ..... *Monolopia congonii* (G<sub>2,13</sub>)
16. Pl glabrous or sticky-glandular; fr 1.5–2 mm ..... <sup>2</sup>**BLENNOSPERMA**
- 16' Pl ± woolly; fr 2.5–3 mm ..... <sup>2</sup>**DIMORPHOTHECA**
- 12' Ray > 1 mm ..... <sup>2</sup>**ARGYRANTHEMUM**
18. Ray white to purple (sometimes multi-colored) ..... *Tanacetum parthenium* (G<sub>13</sub>)
19. Phyllaries unequal, in 2+ series, gen conspicuously overlapping, gen scarious-margined ..... <sup>2</sup>**LEUCANTHEMUM**
20. Subshrub — ray fr 1–3-winged ..... <sup>2</sup>**TRIPLEUROSPERMUM**
- 20' Herb ..... <sup>2</sup>**CALENDULA**
21. Lf 1–3-pinnately dissected; heads short-peduncled, few to many in rounded to ± flat-topped clusters ..... *Tanacetum parthenium* (G<sub>13</sub>)
22. Ultimate lf segments flat ..... <sup>2</sup>**MAURANTHEMUM**
- 22' Ultimate lf segments thread-like ..... *Matricaria chamomilla*
23. Herbage strongly scented; fr obconic, weakly compressed or ± round in ×-section, faintly 5-ribbed, glandular between ribs, ribs without embedded resin glands ..... *Arctotheca calendula*
- 23' Herbage not scented; fr 3-angled, ± compressed, 3–5-ribbed, minutely roughened between ribs, 2–3 ribs distally with embedded resin glands ..... <sup>2</sup>**BLENNOSPERMA**
- 21' Lf entire, serrate or pinnately lobed; heads ± long-peduncled, solitary or few in open, cyme-like cluster ..... <sup>2</sup>**DIMORPHOTHECA**
24. Per; heads 6–9 cm diam ..... <sup>2</sup>**LEUCANTHEMUM**
- 24' Ann; heads 2.5–4(5.5) cm diam ..... <sup>2</sup>**MAURANTHEMUM**
25. Outer phyllary margins and tips not scarious; ray adaxially uniformly pale yellow or with darker yellow proximal band, abaxially steely blue; fr densely woolly ..... *Arctotheca calendula*
- 25' Outer phyllary margins and tips scarious; ray adaxially and abaxially white (aging pink), proximally yellow; fr faces glabrous ..... <sup>2</sup>**BLENNOSPERMA**
- 19' Phyllaries ± equal, in 1–2 series, gen little overlapping, gen not scarious-margined ..... <sup>2</sup>**PENTACHAETA**
26. Ray 25–40 mm; coarse per or subshrub ..... <sup>2</sup>**MONOPTILON** (G<sub>13,14</sub>)
- 26' Ray < 10 mm; ann or slender per ..... <sup>2</sup>**CHRYSANTHEMOIDES**
27. Lf widely ovate, coarsely dentate or palmately lobed, abruptly petioled ..... *Perityle emoryi* (G<sub>2,13,14</sub>)
- 27' Lf linear to obovate, entire to pinnately lobed (tip sometimes 3-lobed), sessile or tapered to petiole ..... <sup>2</sup>**ERIOPHYLLUM** (G<sub>13,14</sub>)
28. Proximal lvs pinnately lobed ..... <sup>2</sup>**SYNTRICHOPAPPUS**
- 28' Lvs entire, toothed, or 3-lobed ..... <sup>2</sup>**BLENNOSPERMA**
29. Per; moist habitats ..... <sup>2</sup>**BELLIS**
- 29' Ann; dry habitats ..... <sup>2</sup>**ERIOPHYLLUM**
30. Pl tomentose or becoming glabrous ..... <sup>2</sup>**ERIOPHYLLUM**
31. Ray not red-veined abaxially; e SnFrB, SnGb, SnBr, PR, SNE, D ..... <sup>2</sup>**Eriophyllum wallacei**
- 31' Ray red-veined abaxially; SCoRI, TR, SnJt ..... <sup>2</sup>**Syntrichopappus lemontii**
- 30' Pl short-hairy ..... <sup>2</sup>**PENTACHAETA**
32. Pl tufted or gen prostrate to ascending; D ..... <sup>2</sup>**MONOPTILON** (G<sub>13,14</sub>)
- 32' Pl ± erect; CW ..... <sup>2</sup>**HETERANTHEMIS** (G<sub>13</sub>)
- 18' Ray yellow to orange (occ multi-colored) ..... <sup>2</sup>**PENTACHAETA** (G<sub>2,14,15</sub>)
33. Fr drupe; shrub ..... <sup>2</sup>**CHRYSANTHEMOIDES**
- 33' Fr achene; gen herb or subshrub (exc *Venegasia*) ..... <sup>2</sup>**GLEBIONIS**
34. Phyllaries unequal, overlapping in several series ..... <sup>2</sup>**TANACETUM** (G<sub>2</sub>)
35. Phyllary margins conspicuously scarious ..... <sup>2</sup>**ARCTOTHECA**
36. Pl sticky-glandular ..... <sup>2</sup>**VENEGASIA**
- 36' Pl not glandular ..... <sup>2</sup>**BLENNOSPERMA**
37. Heads solitary or in open, lfy cymes; outer frs 3-angled ..... <sup>2</sup>**CALENDULA**
- 37' Heads in dense, flat-topped clusters; frs cylindric to obconic ..... <sup>2</sup>**DIMORPHOTHECA**
- 35' Phyllary margins not or barely scarious ..... <sup>2</sup>**HELENIUM** (G<sub>7,13</sub>)
38. Lf oblong to obovate, pinnately lobed, tomentose at least below; phyllaries narrow, appressed or tips spreading or reflexed ..... <sup>2</sup>**BLENNOSPERMA**
- 38' Lf widely ovate, entire to coarsely toothed, puberulent; phyllaries wide, outer spreading or reflexed ..... <sup>2</sup>**CALENDULA**
- 34' Phyllaries ± equal (or outer longer), in 1–3 series, slightly overlapping or not ..... <sup>2</sup>**ARCTOTHECA**
39. Ray fr prickly, knobby, papillate, or ridged on back; phyllary margins gen narrowly scarious ..... <sup>2</sup>**CALENDULA**
40. Involucre gen 5–9 mm; lvs glabrous or sparsely tomentose ..... <sup>2</sup>**VENEGASIA**
- 40' Involucre 10–20 mm; lvs puberulent and/or glandular ..... <sup>2</sup>**BLENNOSPERMA**
41. Ray fr strongly curved [crescent-shaped or almost loop-like]; disk fls staminate ..... <sup>2</sup>**DIMORPHOTHECA**
- 41' Ray fr 3-angled, not curved; disk fls fruiting, fr flat ..... <sup>2</sup>**CALENDULA**
- 39' Ray fr gen smooth on back; phyllary margins gen not scarious ..... <sup>2</sup>**ARCTOTHECA**
42. Head hemispheric to ovoid or ± spheric; phyllaries spreading or reflexed ..... <sup>2</sup>**HELENIUM** (G<sub>7,13</sub>)

- 42' Head cylindric to hemispheric; phyllaries erect or ascending  
 43. Pl green, glabrous to strigose, glandular or puberulent  
   44. Phyllaries in 2–3 series; pl glandular ..... **AMAUROIPSIS (G13)**  
   44' Phyllaries in 1 series; pl not glandular, ± glabrous ..... *Blennosperma nanum*  
 43' Pl ± gray-tomentose  
   45. Rays when dry persistent, papery, reflexed ..... **BAILEYA**  
   45' Rays when dry withering, deciduous  
   46. Ray corolla with small lobe opposite ray ..... **MONOLOPIA**  
   46' Ray corolla without small lobe opposite ray ..... <sup>2</sup>**ERIOPHYLLUM (G7,13)**  
   47. Ann, per, or subshrub; fr 4(5)-angled or outer frs compressed ..... *PSEUDOBIAHIA*  
   47' Ann; fr ± compressed ..... **ERIOPHYLLUM (G7,13)**

**Group 13**

Heads radiate; receptacle epaleate; pappus of scales or awns

1. Lvs and phyllaries dotted or streaked with embedded, translucent oil glands — herbage strongly scented  
 2. Ray pale pink to bright pink-purple ..... **NICOLLETIA (G14)**  
 2' Ray yellow to red  
 3. Phyllaries in 1 series  
   4. Phyllaries free, falling with ray frs; disk pappus gen of bristles ..... **PECTIS (G12,15)**  
   4' Phyllaries fused, persistent; disk pappus of scales ..... **TAGETES**  
 3' Phyllaries in ± 2 series — pappus scales ± divided into 5–10 bristles  
 5. Ann; peduncles 1–5(10) mm ..... **[DYSSODIA]**  
 5' Subshrubs; peduncles 2–15 cm  
   6. Lf toothed or divided into ± flat segments; involucre 10–18 mm ..... **ADENOPHYLLUM (G15)**  
   6' Lf divided into stiff, needle-like segments; involucre 5–6 mm ..... **THYMOPHYLLA**  
 1' Lvs and phyllaries without embedded oil glands (sometimes glandular-hairy or gland-dotted)  
 7. Ray white to pink or purple (occ multi-colored)  
 8. Bien or per  
   9. Lf compound; pappus scales short ..... *Tanacetum parthenium* (G12)  
   9' Lf simple; pappus scales long, bristle-like ..... **TOWNSENDIA (G14)**  
 8' Ann  
   10. Lf wide, palmately lobed or toothed ..... *Perityle emoryi* (G2,12,14)  
   10' Lf ± narrow, entire to fiddle-shaped or pinnately lobed  
   11. Pl puberulent or short-stiff-hairy  
   12. Pl gen prostrate; ray corollas 5–12 mm ..... **MONOPTILON (G12,14)**  
   12' Pl erect; ray corollas < 2 mm ..... <sup>2</sup>**RIGIOPAPPUS (G11,12)**  
 11' Pl tomentose  
   13. Ray 1.5–2.5 mm; pappus scales 2 ..... <sup>2</sup>**EATONELLA (G2)**  
   13' Ray 3–30 mm; pappus scales 6–16 ..... **ARCTOTIS**  
   14. Phyllaries in 3–6+ series; ray (17)20–30 mm ..... *Eriophyllum lanosum*  
 14' Phyllaries in 1 series; ray 3–7 mm .....  
 7' Ray yellow to red, sometimes multi-colored or fading to cream  
 15. Receptacle with stiff awn-like projections ..... **[GAILLARDIA] (G11)**  
 15' Receptacle smooth or pitted and/or minutely hairy, without stiff awn-like projections  
 16. Phyllaries in several series, strongly graduated  
 17. Lf abaxially tomentose; st creeping or decumbent to erect ..... **ARCTOTHECA**  
 17' Lf glabrous to short-hairy; st erect or ascending (rarely decumbent)  
 18. Phyllary tips spreading to recurved; involucre gummy — pappus of 2–6 slender deciduous awns ..... **GRINDELIA (G6,7,15)**  
 18' Phyllary tips ± appressed; involucre not or barely gummy ..... **HETERANTHEMIS (G12)**  
 19. Ann; fr winged; lvs toothed or lobed .....  
 19' Per to shrub; fr not winged; lvs entire ..... *Acamptopappus shockleyi* (G15)  
 20. Body of head ± spheric; disk fls 30–80 .....  
 20' Body of head narrower than length; disk fls 1–13 ..... **AMPHIPAPPUS (G15)**  
 21. Lf elliptic to obovate; disk pappus scales twisted, bristle-like ..... **GUTIERREZIA**  
 21' Lf linear; disk pappus scales straight, wide, flat .....  
 16' Phyllaries in 1–3(4) series, gen ± equal (sometimes outer longer), not strongly graduated  
 22. Lvs basal  
   23. Head 3.5–8 cm diam; ray base gen dark-spotted; fr hairs concealing pappus; sap milky ..... **GAZANIA**  
   23' Head gen < 3 cm diam; ray base not dark-spotted; fr hairs not concealing pappus; sap clear ..... *Hulsea vestita*  
   24. Pl ± densely glandular-hairy ..... **TETRANEURIS**  
   24' Pl not glandular-hairy, often dotted with sessile resin glands .....

- 22' Lvs basal and cauline or all cauline ..... **LASTHENIA** (G<sub>2,12</sub>)
25. Lvs gen opposite throughout (occ distal-most alternate) ..... **PSILOSTROPHE**
- 25' Lvs gen alternate (sometimes proximally opposite) ..... **<sup>2</sup>RIGIOPAPPUS** (G<sub>11,12</sub>)
26. Old ray corolla papery, persistent on fr when dry ..... **AMAUROIPSIS** (G<sub>12</sub>)
- 26' Old ray corolla withering, deciduous from fr ..... **HYMENOXYS**
27. Pappus of rigid, tapered awns; lvs linear, entire ..... **HULSEA**
- 27' Pappus of ± thin scales; lvs various, entire to lobed ..... **HELENIUM** (G<sub>7,12</sub>)
28. Phyllaries in 2–3 gen ± equal series, sometimes outer phyllaries longer ..... **30. Distal st and involucres stalked-glandular; lvs 1–3 × pinnately dissected**
29. Lvs mostly or all deeply linear-lobed or 1–3 × dissected ..... **30' Distal st and involucres not stalked-glandular, glands sessile or sunken; lvs entire or gen 1–2 × dissected into linear lobes**
31. Pappus scales 4, in 2 unequal pairs; pl glandular-hairy ..... **Hymenoxys hoopesii**
- 31' Pappus scales 5–8, equal or not; pl gen not glandular ..... **in age).**
32. Lf narrowly linear, or if blade wider, base long-decurrent on st; disk ± spheric; phyllaries gen ± reflexed ..... **32' Lf not narrowly linear or decurrent; disk hemispheric; phyllaries gen spreading (or reflexed**
33. Pappus scales 4, in 2 unequal pairs; pl glandular-hairy ..... **AMBLYOPAPPUS** (G<sub>2,12</sub>)
- 33' Pappus scales 5–8, equal or not; pl gen not glandular ..... **Monolopia congdonii** (G<sub>2,12</sub>)
34. Pl dotted with sessile resin glands; fr 3–4-angled ..... **<sup>2</sup>EATONELLA** (G<sub>2</sub>)
- 34' Pl densely woolly; fr compressed ..... **35. Disk fr ± compressed; ann**
- 35' Disk fr (exc sometimes outermost) ± cylindric, club-shaped, or 3–4-angled; ann to shrub ..... **36. Subshrub; lvs 8–25 cm, distinctly petioled; pappus scales 2–6+, unequal or, if equal, scales 2,**
- 36' Ann to shrub; lvs ≤ 8 cm, sessile or ± winged-petioled; pappus scales 0 or 6–12+, in 1–2 opposite ..... **CONSTANCEA**
- 36' equal or unequal series ..... **ERIOPHYLLUM** (G<sub>7,12</sub>)

#### Group 14

Heads radiate; rays white to pink, blue, or purple; receptacle epaleate; pappus of bristles

1. Lvs palmately lobed or dentate ..... **Perityle emoryi** (G<sub>2,12,13</sub>)
2. Ann; lvs caulin; pappus bristle 1; SCo, ChI, PR, D ..... **PETASITES** (G<sub>2</sub>)
- 2' Per; lvs basal, caulin lvs reduced to sheathing scales; pappus bristles many; moist forests, NW, n SNH, nw&n-c CW ..... **3' Lvs entire to pinnately lobed**
3. Rays inconspicuous, barely surpassing disk or not ..... **4. Phyllaries with 1–3 resin-filled veins that become orange when dry**
4. Resin-filled phyllary vein 1 ..... **5. Resin-filled phyllary veins gen 3**
- 5' Resin-filled phyllary veins gen 3 ..... **6. Subshrub; branches often thorny**
- 6' Herb; branches not thorny ..... **4' Phyllaries without resin-filled veins that become orange when dry**
7. Disk wide, flat; disk fls many; pappus gen double [outer, inner elements distinct], outer of short bristles ..... **5' ERIGERON** (G<sub>2,6,15</sub>)
- 7' Disk longer than wide; disk fls 4–25+; pappus gen single ..... **8. Fr 1–3 mm, not distally long-tapered; st branches gen not overtopping main st**
- 8' Fr 5–6 mm, distally long-tapered; st branches stiffly ascending, often overtopping main st ..... **3' CHLORACANTHA**
9. Pappus bristles alternating with well-developed scales — pl with strong, pungent odor ..... **5' ERIGERON** (G<sub>2,6,15</sub>)
- 9' Pappus of bristles only or scales very short ..... **3' SYMPHYOTRICHUM**
10. Pappus bristles ≤ 15 ..... **9' TRACYINA** (G<sub>15</sub>)
11. Pappus double, of 1–15 bristles and 5 narrow scales or of 1 plumose-tipped bristle and a low crown ..... **10' NICOLLETIA** (G<sub>13</sub>)
- 11' Pappus single, of 3–5 bristles ..... **12. Bristles distinctly flattened, barbed to ± plumose**
- 10' Pappus bristles gen > 20 ..... **12' Bristles ± cylindric or weakly flattened, smooth to barbed**
12. Bristles distinctly flattened, barbed to ± plumose ..... **13. Main phyllaries ± equal in 1–3(4) series**
- 12' Bristles ± cylindric or weakly flattened, smooth to barbed ..... **14. Pappus ± 1 mm, bristles fused at base; pl woolly**

**MONOPTILON** (G<sub>12,13</sub>)

**PENTACHAETA** (G<sub>2,12,15</sub>)

**TOWNSENDIA** (G<sub>13</sub>)

**SYNTRICHOPAPPUS** (G<sub>15</sub>)

- 14'. Pappus gen >> 1 mm, bristles free; pl gen not woolly
15. Pappus gen double, outer of short bristles or scales (0), inner of soft bristles; rays gen < 2 mm wide ..... <sup>5</sup>ERIGERON (G2,6,15)
- 15'. Pappus single; rays often > 2 mm wide
16. Ann; main phyllaries equal, in 1 series [often with very short outer phyllaries]. ..... *Senecio elegans*
- 16'. Per; main phyllaries ± equal, in 2-3(4) series
17. Heads solitary; lvs all or mostly basal, caulin reduced or 0 ..... OREOSTEMMA
- 17'. Heads clustered; lvs basal and caulin or all caulin ..... <sup>5</sup>SYMPHYOTRICHUM
- 13'. Main phyllaries unequal, graduated in 2-several series
18. Shrub or subshrub
19. Phyllary veins resin-filled, orange when dry; pl often thorny ..... <sup>3</sup>CHLORACANTHA
- 19'. Phyllary veins not resin-filled or orange; pl unarmed
20. Ray fls sterile [style 0, ovary vestigial]; pappus brown or ± red ..... <sup>2</sup>CORETHROGYNE
- 20'. Ray fls fruiting [style present]; pappus gen ± white
21. Ray fls 15-40 mm; lvs often sharply toothed
22. Outer phyllaries ± oblanceolate, tips acute to obtuse, gen reflexed in age; e PR ..... *Dieteria canescens* var. *ziegleri*
- 22'. Outer phyllaries linear to lance-linear, tips sharply acute, not reflexed in age; SNE, D ..... <sup>2</sup>XYLORHIZA
- 21'. Ray fls 5-10 mm; lvs entire
23. Slender subshrub, minutely stalked-glandular, or nonglandular and strigose ..... <sup>2</sup>CHAETOPAPPA
- 23'. Stiff shrub, glabrous, sticky-resinous ..... *Ericameria gilmanii*
- 18'. Herb
24. Ray fls sterile (style 0, ovary ± vestigial)
25. Disk style branch tips densely tufted with stiff yellow hairs; pappus brown or ± red ..... <sup>2</sup>CORETHROGYNE
- 25'. Disk style branches without stiff yellow hairs; pappus ± white
26. Involucr 3-6 mm ..... *Arida arizonica*
- 26'. Involucr 6-9 mm ..... *Dieteria canescens* var. *shastensis*
- 24'. Ray fls fruiting, style present
27. Pappus double, outer of short bristles or scales, inner of long bristles
28. Resin-filled phyllary veins gen 3; st often thorny ..... <sup>3</sup>CHLORACANTHA
- 28'. Resin-filled phyllary veins 0-1; st unarmed
29. Rays narrowly linear, often very many ..... <sup>5</sup>ERIGERON (G2,6,15)
- 29'. Rays oblong, 1-16
30. Disk corolla white — heads in tight clusters at tips of infl branches ..... <sup>2</sup>SERICOCARPUS
- 30'. Disk corolla yellow
31. Heads in cyme-like cluster ..... EUCEPHALUS (G14)
- 31'. Heads solitary ..... IONACTIS
- 27'. Pappus single, or bristles ± equal if more than 1 series
32. Phyllaries ± herbaceous throughout (or margin scarious to ± white) ..... <sup>2</sup>CHAETOPAPPA
33. Lvs 4-12 mm; pl 5-15(20) cm — sts slender, gen branched, very lfy ..... <sup>5</sup>SYMPHYOTRICHUM
- 33'. Lvs gen 30-200 mm; pl often > 20 cm ..... <sup>5</sup>SYMPHYOTRICHUM
- 32'. Phyllary tips ± herbaceous, bases white to straw-colored
34. Ann to per with taproot; lvs ± entire to toothed or pinnately dissected, teeth sometimes bristle-tipped; phyllary tips often spreading ..... <sup>2</sup>XYLORHIZA
35. Heads 3.5-6 cm diam, solitary
- 35'. Heads gen < 3 cm diam, often in cyme-like clusters ..... <sup>5</sup>SYMPHYOTRICHUM
36. Rays 1.3-4 mm.
- 36'. Rays 6-20 mm
37. Lvs entire to toothed
- 37'. Lvs 1-2-pinnately dissected
- 34'. Per with rhizome or caudex; lvs entire to toothed; phyllary tips gen appressed
38. Heads in tight clusters at tips of infl branches; disk corolla white ..... <sup>2</sup>SERICOCARPUS
- 38'. Heads in raceme-like or flat-topped cluster or 1 at tips of long infl branches; disk corolla yellow or tinged pink or purple
39. Phyllaries glabrous or hairy
40. Disk corolla tube ≥ throat; fr ribs 7-10
- 40'. Disk corolla tube < throat; fr ribs (1)2-6 (5-8 in *Symphyotrichum defoliatum*) ..... <sup>5</sup>SYMPHYOTRICHUM
- 39'. Phyllaries densely glandular
41. Head solitary at tips of long infl branches; caulin lvs ± linear, grass-like
- 41'. Heads in raceme-like, panicle-like, or ± flat-topped cluster; caulin lvs linear to (ob)lanceolate or obovate, grass-like or not
42. Involucr 8-14 mm; disk corolla 6-7.8 mm, pale yellow, aging ± pink or purple ..... *Eurybia integrifolia*
- 42'. Involucr 5.5-8 mm; disk corolla 4.5-6 mm, yellow ..... *Symphyotrichum campestre*

## Group 15

Heads radiate; rays yellow to red; receptacle epaleate; pappus of bristles

1. Lvs opposite at least proximally ..... <sup>3</sup>**ADENOPHYLLUM** (G13)  
 2. Lvs and phyllaries dotted or streaked with embedded, translucent oil glands, strongly scented ..... <sup>3</sup>**ADENOPHYLLUM** (G13)  
   3. Lvs sharply toothed to pinnately dissected; phyllaries in 2 series ..... <sup>PECTIS</sup> (G12,13)  
     3' Lvs linear, entire, base bristly-ciliate; phyllaries 8, in 1 series ..... <sup>JAUMEA</sup>  
     2' Lvs and phyllaries without embedded oil glands, not or faintly scented ..... <sup>JAUMEA</sup>  
       4. Trailing fleshy per; pappus bristles 1–5; coastal saline habitats ..... <sup>ARNICA</sup> (G6)  
       4' Erect ann or per, not fleshy; pappus bristles many; inland ..... <sup>2</sup>**SYNTRICHOPAPPUS** (G14)  
       5. Per, gen from rhizome; involucre gen 8–20 mm; pappus bristles > 2 mm, free ..... <sup>ARNICA</sup> (G6)  
       5' Ann; involucre 5–7 mm; pappus bristles 1–2 mm, fused at base ..... <sup>2</sup>**SYNTRICHOPAPPUS** (G14)
- 1' Lvs alternate throughout
6. Ann or bien
7. Phyllary tip with a prominent tack-shaped gland; disk fls staminate ..... <sup>BENITO</sup>  
    7' Phyllary tip without a prominent tack-shaped gland; disk fls bisexual ..... <sup>2</sup>**CROCIDIUM**  
     8. Ray fr pappus 0 [disk fr pappus present] ..... <sup>2</sup>**HETEROTHECA**  
       9. Phyllaries in 1 series, fused at base ..... <sup>9'</sup>  
       9' Phyllaries in 2–several series, free ..... <sup>9'</sup>  
       8' Ray [and disk] frs with pappus ..... <sup>9'</sup>  
       10. Main phyllaries unequal, in 2–several series ..... <sup>3</sup>**GRINDELIA** (G6,7,13)  
         11. Pappus bristles flat, deciduous; involucre gummy-resinous ..... <sup>11'</sup>  
         11' Pappus bristles gen ± cylindric or flattened only at base, gen persistent; involucre not gummy-resinous ..... <sup>3</sup>**PULICARIA**  
         12. Pappus double, outer of short scales, inner of 8–16+ bristles ..... <sup>12'</sup>  
         12' Pappus single or, if double, of bristles throughout ..... <sup>13'</sup>  
           13. Fr distally long-tapered; rays 1–1.5+ mm ..... <sup>13'</sup>  
           13' Fr not distally long-tapered; rays ≤ 12 mm ..... <sup>Xanthisma gracile</sup>  
           14. Lvs serrate to 1–2-pinnately lobed ..... <sup>14'</sup>  
           14' Lvs entire to finely toothed ..... <sup>15.</sup>  
           15. Pl sticky-glandular, strongly aromatic; heads many in dense raceme- or ± panicle-like clusters ..... <sup>DITTRICHIA</sup>  
           15' Pl not glandular, not aromatic; heads solitary or few in open, ± flat-topped cluster ..... <sup>2</sup>**PENTACHAETA** (G2,12,14)
- 10' Main phyllaries ± equal, in 1–3 series
16. Phyllary margins evidently scarious
17. Rays 3–12 mm; pappus single, of 5–20 bristles ..... <sup>2</sup>**PENTACHAETA** (G2,12,14)  
   17' Rays 1.5–2 mm; pappus double, outer of short scales, inner of 8–16+ bristles ..... <sup>3</sup>**PULICARIA**  
   16' Phyllary margins not or only slightly scarious (exc alternate phyllaries in *Syntrichopappus*) ..... <sup>18.</sup>  
   18. Receptacle conic; phyllaries fused at base ..... <sup>18'</sup>  
   18' Receptacle ± flat; phyllaries free ..... <sup>19.</sup>  
   19. Phyllaries gen 5, ± enfolding ray frs ..... <sup>19'</sup>  
   19' Phyllaries gen 8, 13, or 21, not enfolding ray frs ..... <sup>2</sup>**SYNTRICHOPAPPUS** (G14)  
   20. Pl with short, button-like caudex, with many fleshy-fibrous, unbranched roots ..... <sup>20'</sup>  
   20' Pl tap- or fibrous rooted, without fleshy-fibrous, unbranched roots ..... <sup>7</sup>**SENECIO** (G2,6)  
   21. Phyllary tips black ..... <sup>21'</sup>  
   21' Phyllary tips green ..... <sup>22.</sup>  
   22. Rays 7–15+ mm; bien ..... <sup>22'</sup>  
   22' Rays ≤ 3 mm; slender ann. ..... <sup>2</sup>**PACKERA** (G6)  
   6' Per to shrub ..... <sup>2</sup>**SENECIO** (G2,6)
23. Shrub or subshrub
24. Outer phyllaries with an embedded, translucent oil gland near tip; pl strongly pungent-scented
- 24' Outer phyllaries without oil glands; pl scented or not ..... <sup>3</sup>**ADENOPHYLLUM** (G13)  
   25. Main phyllaries in 1 series, equal (often a few, gen much shorter, outer phyllaries present) ..... <sup>7</sup>**SENECIO** (G2,6)  
   25' Main phyllaries in 2–7 series, often graduated, often unequal ..... <sup>26.</sup>  
   26. Pappus bristles flattened; phyllaries ± ovate ..... <sup>27.</sup>  
   27. Phyllary tips recurved to coiled; involucre gummy; ray fls 20–60 ..... <sup>27'</sup>  
   27' Phyllary tips ± appressed; involucre ± resinous but not gummy; ray fls 1–14 ..... <sup>3</sup>**GRINDELIA** (G6,7,13)  
   28. Rays 5–14, >> involucre; disk fls 30–80, fruiting ..... <sup>28'</sup>  
   28' Rays 1–2, barely > involucre; disk fls 3–7, staminate ..... <sup>26'</sup>  
   26' Pappus bristles ± cylindric; phyllaries gen linear to narrowly lanceolate ..... <sup>Acamptopappus shockleyi</sup> (G13)  
   29. Woody sts ± prostrate, pl cushion-forming ..... <sup>30.</sup>  
   30. Lvs 1-veined, linear, of uniform size throughout ..... <sup>30'</sup>  
   30' Lvs 3-veined, narrowly elliptic to oblanceolate, distal reduced ..... <sup>2</sup>**NESTOTUS**  
     <sup>2</sup>**STENOTUS**

- 29' Woody sts gen erect or ascending
31. Phyllaries  $\pm$  graduated in 2–4 series, bases loose to tightly appressed, tips weakly thickened, or not, green or straw-colored, never tomentose; lvs entire ..... **ERICAMERIA** (G6)
- 31' Phyllaries strongly graduated in 5–7 series, bases tightly appressed, straw-colored, tips clearly thickened, green (sometimes phyllaries densely tomentose); lvs often toothed
32. Distal lvs gen not much reduced ..... **HAZARDIA** (G6)
- 32' Distal lvs reduced to scale-like bracts ..... **<sup>2</sup>XANTHISMA**
- 23' Herb
33. Outer phyllaries with an embedded, translucent oil gland near tip; pl strongly pungent-scented ..... **<sup>3</sup>ADENOPHYLLUM** (G13)
- 33' Outer phyllaries without oil glands; pl scented or not
34. Main phyllaries in 1 series, equal [often with a few, very short, outer phyllaries]
35. St from an abruptly shortened, button-like caudex, with many fleshy-fibrous, unbranched roots ..... **<sup>7</sup>SENECIO** (G2,6)
- 35' St from a taproot, caudex, or rhizome, never with an abruptly shortened, button-like caudex
36. Lvs  $\pm$  equal,  $\pm$  evenly distributed along st or crowded distally at fl ..... **<sup>7</sup>SENECIO** (G2,6)
- 36' Lvs reduced distally; proximal lvs prominent, gen persistent
37. St from thin taproot, caudex, or rhizome; roots fibrous, branched; lf  $\pm$  entire to pinnately lobed, marginal teeth not hard, not translucent ..... **<sup>2</sup>PACKERA** (G6)
- 37' St from thick, creeping or erect rhizome; roots fleshy, unbranched; lf dentate to minutely dentate, marginal teeth hard, translucent — lf tapered to winged petiole ..... **<sup>7</sup>SENECIO** (G2,6)
- 34' Phyllaries in 2+ series,  $\pm$  equal to strongly graduated
38. Disk pappus double, outer of very short bristles or scales
39. St simple, erect; phyllaries  $\pm$  equal — fr 2-ribbed ..... **ERIGERON** (G2,6,14)
- 39' St gen branched, prostrate to erect; phyllaries gen  $\pm$  unequal
40. Rays 3–12 mm; disk fr 1.5–4 mm,  $\pm$  flat; pappus 3–7 mm ..... **<sup>2</sup>HETEROTHECA**
- 40' Rays 1.5–2.5 mm; disk fr  $\pm$  1 mm,  $\pm$  cylindric or fusiform; pappus 2–3 mm
41. Outer pappus of bristles, 1.5 mm; anther base appendages 0 ..... **<sup>2</sup>EUTHAMIA**
- 41' Outer pappus a crown of  $\pm$  fused scales, < 0.4 mm; anther base appendages bristle-like ..... **<sup>3</sup>PULICARIA**
- 38' Disk pappus single
42. Pappus bristles flat, deciduous; involucre strongly gummy-resinous, esp in bud ..... **<sup>3</sup>GRINDELIA** (G6,7,13)
- 42' Pappus bristles  $\pm$  cylindric, gen persistent; involucre not strongly gummy-resinous
43. Lf toothed or lobed
44. Heads gen small, in racemes or panicles, often clustered on 1 side of branches ..... **<sup>2</sup>SOLIDAGO**
- 44' Heads gen not small, not in 1-sided clusters
45. Basal rosette well developed
46. Pl with stout taproot; sts, lvs glabrous or tomentose to woolly and/or stalked-glandular; fr 3–4 angled ..... **<sup>2</sup>PYRROCOMA**
- 46' Pl with branched caudex, taprooted; sts, lvs stalked-glandular, sticky, otherwise glabrous; fr not 3–4 angled ..... **<sup>2</sup>TONESTUS**
- 45' Rosette 0 or poorly developed
47. Fr 2–3 mm, obconic; lf teeth or lobes bristle- or minutely spine-tipped ..... **<sup>2</sup>XANTHISMA**
- 47' Fr 3–10 mm,  $\pm$  cylindric or compressed; lf margin not bristle- or minutely spine-tipped
48. Fr 5–10 mm, glabrous; phyllaries in 4–5 series, strongly graduated ..... *Hazardia whitneyi*
- 48' Fr 2.5–6 mm, hairy; phyllaries inn 3–4 series,  $\pm$  equal or weakly graduated ..... **<sup>2</sup>TONESTUS**
- 43' Lf entire
49. Phyllaries in vertical ranks; disk fls staminate ..... **PETRADORIA**
- 49' Phyllaries not in vertical ranks; disk fls fruiting
50. Heads small, in clusters at branch tips; infl lf, panicle-like or  $\pm$  flat-topped; st erect from rhizome; fr  $\pm$  1 mm ..... **<sup>2</sup>EUTHAMIA**
- 50' Heads small to large, 1–several; infl various; st from taproot, caudex, or rhizome; fr gen >> 1 mm ..... **<sup>2</sup>PYRROCOMA**
51. Pl with stout taproot — basal rosette well developed
- 51' Pl with  $\pm$  branched caudex or rhizome ..... *Tonestus lyallii*
52. Pl densely long-stalked-glandular ..... **<sup>2</sup>SOLIDAGO**
- 52' Pl glandless or short-stalked-glandular
53. Rays 1–6 mm; cauline lvs distributed well up st
- 53' Rays 7–12 mm; cauline lvs gen only at st base ..... **<sup>2</sup>NESTOTUS**
54. Lvs 1-veined, linear to oblanceolate, of uniform size throughout ..... **<sup>2</sup>STENOTUS**
- 54' Lvs 3-veined, narrowly elliptic to oblanceolate, distal reduced

*T. ramosa* Torr. (p. 727) DESERT TRAGIA Pl rough-hairy. ST: 1–3 dm. LF: stipules 1–4.5 mm, lanceolate to ovate; petiole 2–20 mm; blade 1–2 cm, lanceolate to ovate, base truncate to ± lobed, margin coarsely, sharply toothed. INFL: 0.5–1 cm, ± spreading; pedicels 1–2 mm; staminode fls 2–4; pistillate fl 1. STAMINATE FL: sepals 1–2 mm, recurved; stamens 3–6, filaments ± flattened. PISTIL: 4–5, ± 1 mm, recurved; stamens 3–6, filaments ± flattened.

LATE FL: sepals 5, 1.5–2 mm; ovary < 2 mm diam, puberulent to finely bristly, styles fused in proximal 1/3. FR: 3–4 mm, 6–8 mm wide, depressed-spheric, sparsely and finely bristly. SEED: 2.5–3.5 mm, ± spheric. Dry, rocky slopes, scrub, pinyon/juniper woodland; 900–1900 m. DMtns; to c US, TX, Mex. [*T. stylaris* Müll. Arg.]

## TRIADICA

### TALLOWTREE

Bruce G. Baldwin

Tree [shrub]; sap milky; monoecious. ST: branches slender, glabrous. LF: caulin, alternate; petiole tip with adaxial pair of large, ± spheroid glands; blade entire, adaxially glabrous, abaxially papillate-glaucous, with 0–few glands near margins. INFL: spike-like panicles or racemes, terminal or axillary, elongate, yellow-green; bracts 1–2 mm, with pair of large glands; pedicels 2–3 mm in ours; pistillate fls basal, 1/bract; staminode fls distal or throughout, gen 5–8/bract. STAMINATE FL: sepals 3, fused; stamens 2 or 3, filaments gen < 1 mm; nectary disk 0. PISTILLATE FL: sepals 3, fused; nectary disk 0; ovary 3-chambered, styles 3, fused proximally, simple. FR: ± spheric or ± 3-lobed, smooth. SEED: ± white, often staying attached to persistent fr axis. 3 spp.: native to e & se Asia. (Greek: 3, for lobes of calyx, ovary, fr) [Bower et al. 2009 Inv Pl Sci Managem 2:386–395; Esser 2002 Harvard Pap Bot 7:17–21]

*T. sebifera* (L.) Small CHINESE TALLOWTREE Pl to 13 m; deciduous. LF: petiole 2–7 cm; blade 3–9 cm, widely elliptic to ± (ob) ovate or triangular-(ob)ovate, acuminate. INFL: 4–16 cm. PISTIL-

LATE FL: 0–17. FR: ± 13 mm; pedicel 4–13 mm. SEED: 6–9 mm, ± spheric. Stream edges; 10–300 m. n SNF, GV; native to Asia. [*Sapium* s. (L.) Roxb.] Spring–summer ♦

## FABACEAE (Leguminosae) LEGUME FAMILY

Martin F. Wojciechowski, except as noted

Ann to tree. LF: gen alternate, gen compound, gen stipuled, gen entire, pinnately veined INFL: gen raceme, spike, umbel or head; or fls 1–few in axils. FL: gen bisexual, gen bilateral; hypanthium 0 or flat to tubular; sepals gen 5, gen fused; petals gen 5, free, fused, or lower 2 ± united into keel (see 3, Key to Groups, for banner, wings); stamens 10 or many (or [1], 5, 6, 7, 9), free or fused or 10 with 9 filaments at least partly fused, 1 (uppermost) free; pistil 1, ovary superior, gen 1-chambered, ovules 1–many, style, stigma 1. FR: legume, incl a stalk-like base (above receptacle) or not. SEED: 1–many, often ± reniform, gen hard, smooth. ± 730 genera, 19400 spp.: worldwide; with grasses, requisite in agriculture, most natural ecosystems. Many cult, most importantly *Arachis*, peanut; *Glycine*, soybean; *Phaseolus*, beans; *Medicago*, alfalfa; *Trifolium*, clovers; many orn. [Lewis et al. (eds) 2005 Legumes of the World. RBG, Kew] Unless stated otherwise, fr length incl stalk-like base, number of 2° lflets is per 1° lflet. Upper suture of fr adaxial, lower abaxial. *Anthyllis vulneraria* L. evidently a waif, a contaminant of legume seed from Eur. *Laburnum anagyroides* Medik., collected on Mount St. Helena in 1987, may be naturalized. *Ceratonia siliqua* L., carob tree (Group 2), differs from *Gleditsia triacanthos* L. in having evergreen (vs deciduous) lvs that are 1-pinnate (vs 1-pinnate on spurs on old sts, 2-pinnate on new sts) with 2–5(8) (vs 7–17) 1° lflets, commonly cult, now naturalized in s CA. *Aeschynomene rudis* Benth. ♦, *Halimodendron halodendron* (Pall.) Voss ♦ (possibly extirpated), *Lens culinaris* Medik. are agricultural weeds. *Caragana arborescens* Lam. only cult. *Ononis alopecuroides* L. ♦, *Sphaerophysa salsula* (Pall.) DC. ♦ all evidently extirpated. *Cercidium* moved to *Parkinsonia*; *Chamaecytisus* to *Cytisus*; *Psoralidium lanceolatum* to *Ladeania*. Scientific Editors: Martin F. Wojciechowski, Thomas J. Rosatti.

### Key to Groups

1. Fl radial; calyx, corolla gen inconspicuous; petals free or fused, lobes not overlapped in bud; stamens 10 or gen many, often long-exserted; lf 2-pinnate (simple in alien *Acacia*) . . . . . Group 1: Mimosoideae
- 1' Fl gen bilateral, less often ± radial; calyx, corolla gen conspicuous; petals overlapped in bud, free or 2 lowermost ± fused; stamens 10 (or 5, 6, 7, 9), gen ± incl; lf 1- or 2-pinnate (less often simple or palmately compound)
2. Fl ± radial to ± bilateral; sepals fused only at very base; lf 1- or 2-pinnate . . . . . Group 2: Caesalpinoideae (exc *Cercis*)
- 2' Fl bilateral; sepals free to ± entirely fused; lf simple, 1-pinnate, or palmate
3. Upper petal (banner) inside lateral ones (wings) in bud; stamens free; lf simple, reniform or bi-lobed
- 3' Upper petal (banner) outside lateral ones (wings) in bud (only banner present in *Amorpha*, petal position not evident in some *Dalea*); stamens gen with all or 9 filaments fused (free in *Thermopsis*, *Pickeringia*, *Calia*); lf 1-pinnate (lflets often 3), some palmately compound (esp *Lupinus*) or simple . . . . . Group 3: Papilionoideae

### Group 1

#### Mimosoideae

#### PROSOPIS

1. Stamens 10; 1° lflets gen 2–4 . . . . .
- 1' Stamens > 10; 1° lflets gen > 4, or lf simple . . . . .

2. Filaments fused below, free above; lf 2-pinnate  
 3. Infl axillary spike-like racemes or ± terminal panicle of head-like racemes; petiole with a gland; fr not  
     or slowly dehiscent, valves not recurving; ScV, CCo, SnFrB, SCORO, SW.....  
 3' Infl axillary heads; petiole without a gland; fr dehiscent, valves recurving; DSon.....  
 2' Filaments free; lf 2-pinnate or simple  
 4. Pl unarmed.....  
 4' Pl armed with prickles or stipular spines.....  
 5. Pl armed with prickles.....  
 5' Pl armed with stipular spines.....  
 6. Lf simple.....  
 6' Lf 2-pinnate .....

**Group 2**

## Caesalpinoideae

CERCIS

1. Lf simple; corolla pink-purple.....  
 1' Lf compound; corolla gen ± yellow.....  
 2. Lf 1-pinnate, pl unarmed or main lf axis gen > 2 cm, a weak spine at tip; corolla gen yellow .....
- 2' Lf gen 2-pinnate (both 1- and 2-pinnate in some), pl armed, main lf axis gen < 2 cm (exc *Gleditsia*), a strong spine at tip, or (if lf interpreted as 1-pinnate; see *Parkinsonia*), lf subtended by a strong spine gen < 2 cm and main lf axis not a spine at tip; corolla ± yellow to orange, less often ± red or with orange to ± red marks .....
3. Fl ± 3–5 mm; sepals, petals ± alike in color, texture; pl tree, gen armed.....  
 3' Fl > 5 mm; sepals, petals not alike in color, texture; pl per, shrub, small tree, armed or not .....
4. Pl unarmed.....  
 5. Shrub, small tree, < 4 m; 2° lflets 14–22 .....
- 5' Per, shrub, < 30 cm or < 2.5 m; 2° lflets 3–13 .....
- 4' Pl armed.....  
 6. Pl with scattered prickles; sepals not alike; fr indehiscent .....
- 6' Pl with stipular spines at nodes or thorns in lf axils (see lf scars) or main lf axis a strong spine; sepals alike; fr indehiscent to partly dehiscent late .....

GLEDTISIA

2CAESALPINIA

HOFFMANNSEGGIA

2CAESALPINIA

PARKINSONIA

**Group 3**

## Papilionoideae

1. Shrub to tree  
 2. Pl gen armed with prickles, spines, or thorns  
 3. Lvs simple, sometimes small or falling early  
 4. Pl gland-dotted; corolla indigo blue to pink-purple; seed 1 .....
- 4' Pl not gland-dotted; corolla yellow to ± red; seeds (1)2–several .....
5. Corolla red-purple; fr narrowed between seeds, glabrous .....
- 5' Corolla yellow; fr not narrowed between seeds, densely hairy .....
- 3' Lvs all or mostly compound, gen persistent  
 6. Lf simple or palmately compound; all filaments free .....
- 6' Lf pinnately compound; all or 9 filaments fused .....
7. Pl gland-dotted; fr indehiscent; seed 1 .....
- 7' Pl not gland-dotted; fr dehiscent (sometimes slowly so); seeds gen several .....
8. Lf even-pinnate; corolla wings purple-pink suffused with white, banner, keel yellow-white to pink or purple; fr not flat, gen narrowed between seeds .....
- 8' Lf odd-pinnate; corolla white or pink; fr flat, not narrowed between seeds .....
- 2' Pl unarmed  
 9. Petal 1 (the banner) — infl spike-like; fr indehiscent; seed 1 .....
- 9' Petals 5 .....
10. Filaments all fused; lvs simple or ternately or palmately compound  
 11. Lvs simple, < 2.5 cm; sts gen ± lfless .....
- 11' Lvs simple or gen compound, gen > 2.5 cm; sts lf'y .....
12. Lf of 3–17 lflets, palmately compound; corolla blue, purple, white, or yellow, banner glabrous to densely hairy, keel gen beaked .....
- 12' Lf of 1–3 lflets, appearing simple or not; corolla yellow or white, banner gen glabrous, keel obtuse .....
13. Style gen abruptly curved at ± middle or gently curved ± throughout; upper lip of calyx 2-lobed .....
- 13' Style ± abruptly bent at tip; upper lip of calyx 2-lobed .....
- 10' Filaments all free or 9 fused, 1 (uppermost) free or 0; lvs gen odd-pinnately compound (or lflet number, arrangement gen irregular, as sometimes in *Acmispon*) .....
14. Infl gen an umbel or fls 1–2; corolla gen yellow .....

- 14' Infl a raceme; corolla yellow or not  
 15. Corolla yellow with dark marks; fr papery, inflated .....  
 15' Corolla white or pink to purple; fr not papery, not inflated ..... COLUTEA  
 16. Fl 6–10 mm; pl gland-dotted; fr indehiscent; seed 1 (see also *Marina*) .....  
 16' Fl 14–25 mm; pl not gland-dotted; fr dehiscent or not; seeds several ..... <sup>4</sup>PSOROTHAMNUS  
 17. Fr dehiscent, flat, not narrowed between seeds; filaments 9 fused, 1 free; corolla ± white to pink... <sup>2</sup>ROBINIA  
 17' Fr indehiscent, not flat, ± narrowed between seeds; filaments all free; corolla ± blue-purple .....  
 .... [Cali *secundiflora*]
- 1' Ann, bien, per, vine, subshrub  
 18. Lflets 0, but stipules lflet-like — lf axis ending as a tendril .....  
 18' Lflets 2–many ..... <sup>3</sup>LATHYRUS  
 18' Lflets compound, lflets gen 3–9  
 19. Lf palmately compound, lflets gen 3–9 .....  
 20. All filaments free; corolla yellow, 15–25 mm .....  
 20' All or 9 filaments fused; corolla not yellow or, if so, gen < 15 mm ..... THERMOPSIS  
 21. Lflets gland-dotted; fr indehiscent or transversely dehiscent; seed 1 .....  
 22. Lvs ± basal or clustered near st tips; lflets elliptic to oblanceolate or widely obovate; fr incl in calyx  
 exc for beak .....  
 22' Lvs caudine; lflets obovate to linear; fr exserted from calyx ..... PEDIOMELUM  
 21' Lflets not gland-dotted; fr indehiscent or dehiscent through longitudinal sutures; seeds gen several ..... LADEANIA  
 23. Filaments of all stamens fused; lflets gen 5–9, entire .....  
 23' Filaments of 9 stamens fused, the 10th (uppermost) free; lflets 3–5, entire, toothed, or wavy ..... <sup>2</sup>LUPINUS  
 24. Lflets 3–9, lower 2 in stipular position or not, others ± palmately arranged, stipules gland-like,  
 reduced to bumps, or inconspicuous, infl an umbel or 1–3-fld, corolla gen yellow (see also *Acmispon*)... LOTUS  
 24' Lflets gen 3, lower 2 not in stipular position, stipules gen papery or membranous, not reduced to  
 bumps, not inconspicuous, rarely lflet-like, if so then infl not an umbel and corolla not yellow .....  
 25. Lflet entire; fr not enclosed in corolla .....  
 25' Lflet ± toothed or wavy; fr gen enclosed in corolla ..... <sup>3</sup>ASTRAGALUS  
 19' Lf pinnately to subpalmately compound (axis apparent beyond lowermost lflets), lflets 2–many .....  
 26. Lflets 2; main lf axis ending as tendril or bristle .....  
 26' Lflets ≥ 3; main lf axis ending as lflet, tendril, or bristle ..... <sup>3</sup>LATHYRUS  
 27. Lflets 3; fr gen indehiscent (gen dehiscent in *Phaseolus*) ..... PHASEOLUS  
 28. Keel petals spirally coiled; lflet gen lobed — trailing or twining vine .....  
 28' Keel petals not spirally coiled; lflet entire, toothed, or wavy .....  
 29. Lflet toothed or wavy — fr ovate or reniform, gen 1-seeded, or ± coiled, several-seeded ..... <sup>2</sup>TRIFOLIUM  
 30. Corolla persistent, enclosing fr, yellow, 3.5–5 mm .....  
 30' Corolla deciduous, yellow or not, 3.5–5 mm or not ..... <sup>2</sup>MEDICAGO  
 31. Fr spirally coiled (or sickle-shaped or straight), gen prickly; seeds 1–several .....  
 31' Fr not spirally coiled, not prickly; seeds 1–2 ..... <sup>2</sup>MEDICAGO  
 32. Fr reniform, ridges gen net-like; corolla 2–3 mm .....  
 32' Fr ovate, ridges transverse to finely net-like; corolla 2.5–7 mm ..... MELILOTUS  
 29' Lflet not toothed, not wavy .....  
 33. Pl not gland-dotted; seeds gen 2–several; fr exserted from calyx or incl exc for beak .....  
 34. Infl an umbel; fr exserted from calyx or incl exc for beak ..... <sup>3</sup>ACMISPON  
 34' Infl a raceme; fr exserted from calyx ..... <sup>3</sup>ASTRAGALUS  
 33' Pl ± gland-dotted; seed 1; fr gen incl in calyx exc for beak ..... RUPERTIA  
 35. Corolla cream to yellow; calyx conspicuously swollen in fr .....  
 35' Corolla at least partly blue to purple; calyx swollen or not in fr .....  
 36. Calyx swollen in fr; bracts at each node, esp lower, of infl united into fan-shaped, 3–5 toothed  
 blade .....  
 36' Calyx not (or only ±) swollen in fr; bracts at nodes of infl not united ..... HOITA  
 27' Lflets > 3 on all or most lvs; fr dehiscent or not ..... SESBANIA  
 37. Lf even-pinnate, main axis ending as a bristle or tendril or not .....  
 38. Lflets ± 20–60; fr 4–8 cm or 15–20 cm; pl ann, shrub, small tree ..... PISUM  
 38' Lflets < 30; fr gen < 8 cm; pl ann, per .....  
 39. Stipules lflet-like, often > lflets; style longitudinally folded; lflets 4–6, glabrous .....  
 39' Stipules gen not lflet-like but sometimes ± = lflets; style not longitudinally folded; lflets 4–many,  
 hairy or glabrous .....  
 40. Style ± flat, puberulent near ± middle for ± 1/3–1/2 length adaxially; lflets ± rolled in bud ..... <sup>3</sup>LATHYRUS  
 40' Style gen not ± flat, puberulent at tip, all around or esp abaxially; lflets folded in bud ..... Vicia  
 37' Lf odd-pinnate, main axis ending as a lflet .....  
 41. Corolla wings << keel; lflets adaxially finely red-dotted; fr 1-seeded, leathery, strongly  
 net-ridged .....  
 41' Corolla wings ± = keel; lflets adaxially dark gland-dotted or not, not red-dotted; fr not  
 simultaneously 1-seeded, leathery, and strongly net-ridged ..... ONOBRYCHIS

42. Pl gland-dotted on sts, lflets, or both; fr indehiscent ..... *GLYCYRRHIZA*
43. Fr several-seeded, long-exserted from calyx, glabrous or with bristles or prickles; lflets 6–10 mm wide ..... *PSOROTHAMNUS*
- 43' Fr 1-seeded, incl in calyx, glandular; lflets gen < 6 mm wide ..... *DALEA*
44. Petals from receptacle; stamens 10; infl head-like or not ..... *MARINA*
- 44' Petals, exc banner, from side or top of column of fused filaments; stamens 5 or 9–10; infl not head-like ..... *DALEA*
45. Pl prostrate to decumbent ..... *MARINA*
46. St gland-dotted ..... *MARINA*
- 46' St not gland-dotted ..... *MARINA*
- 45' Pl ascending to erect ..... *MARINA*
47. Infl a dense spike; stamens 5 ..... *ACMISPON*
- 47' Infl an open raceme; stamens 9–10 ..... *CORONILLA*
- 42' Pl not obviously gland-dotted; fr dehiscent or not ..... *HOSACKIA*
48. Fls 1–2 or several to many in umbel ..... *MARINA*
49. Stipules gland-like, often not apparent; fr exserted or not, ovate to oblong ..... *PETERIA*
- 49' Stipules conspicuous, scarious or lflet-like; fr exserted, gen linear to lanceolate ..... *ORNITHOPUS*
50. Infl gen 10–20-fld umbel; fr indehiscent, segments 1–12 ..... *ASTRAGALUS*
- 50' Infl several-fld umbel or 1–2-fld; fr dehiscent, segments 0 ..... *OXYTROPIS*
- 48' Fls (1–2 or) many in spike to raceme that is head-like or not ..... *MARINA*
51. Seed 1; lflet tip with gland; infl a spike, dense, ± 1 cm ..... *MARINA*
- 51' Seeds several; lflet tip without gland; infl a spike or raceme, dense or not, gen > 1 cm ..... *MARINA*
52. Fr indehiscent, breaking into 1-seeded segments; corolla 6–9 mm; lflet gen < 6 mm ..... *PETERIA*
- 52' Fr gen dehiscent (sometimes slowly so), not breaking into 1-seeded segments; corolla often > 9 mm; lflet often > 6 mm ..... *ORNITHOPUS*
53. Style tip or stigma finely hairy; stipules spiny, free ..... *ORNITHOPUS*
- 53' Style tip and stigma glabrous; stipules not spiny, free or fused ..... *ORNITHOPUS*
54. Keel tip rounded to acute (or short-beaked); fr 1-chambered, if ± 2-chambered then septum from lower suture, rarely fusing with narrow flange from upper suture ..... *ASTRAGALUS*
- 54' Keel tip beaked; fr ± 2-chambered, septum from upper suture, partial to complete ..... *OXYTROPIS*

## ACACIA

David Seigler & John E. Ebinger

Shrub, tree, armed or not; gen evergreen. **LF**: even-2-pinnate or, if simple, true blades 0, petioles, main axes blade-like, with 1 prominent midvein or ≥ 2 gen prominent longitudinal veins; gen alternate, gen with a swollen, joint-like thickening at base that governs orientation, main axis with raised glands or not. **INFL**: head, gen axillary, 1 or in raceme or panicle, or fls in spike; staminate fls often present. **FL**: radial; sepals, petals 4–5, inconspicuous; stamens many, conspicuous, exserted, free; ovary simple. **FR**: gen dehiscent, occ tardily so, flat or ± cylindric. **SEED**: aril gen enlarged, forming cap or completely encircling seed. ± 960 spp.: trop, subtrop, esp Australia. (Greek: sharp point) [Orchard & Wilson 2001a, 2001b, (eds) Fl Australia. Vol 11. Mimosaceae, *Acacia*, part A and B. ABRS] Recognition of *Acacia*, *Senegalia* (incl *A. greggii*), *Vachellia* (incl *A. farnesiana*) current consensus; many Australian spp. cult, incl *A. cultriformis* G. Don, *A. elata* Benth., some naturalized, spreading in CA.

1. Lvs 2-pinnate
2. 1° lflets 2–5 pairs ..... *A. baileyana*
- 2'. 1° lflets gen > 6 pairs (3–13)
3. Twigs winged; 2° lflets ≥ 10 mm ..... *[A. decurrens]*
- 3'. Twigs angled; 2° lflets < 7 mm ..... *[A. dealbata]*
4. Lf main axis with raised glands at each 1° lflet pair; fr glabrous, silver-blue ..... *[A. mearnsii]*
- 4'. Lf main axis with raised glands at most 1° lflet pairs and gen between; fr ± hairy, dark brown. .... *[A. paradoxa]*
- 1'. Lvs simple
5. Lf < 40 mm
6. Stipular spines present; heads 1. .... *[A. podalyriifolia]*
- 6'. Stipular spines 0; heads in racemes ..... *[A. verticillata]*
7. Lf > 4 mm wide, tip not spine-like. .... *[A. pycnantha]*
- 7'. Lf ≤ 1.5 mm wide, tip spine-like. .... *[A. retinodes]*
- 5'. Lf gen > 40 mm
8. Lf with 1 prominent midvein
9. Petiole base 4–8 mm; raceme, occ panicle of 10–30 heads. .... *[A. saligna]*
- 9'. Petiole base ≤ 4 mm; raceme of 2–9 heads
10. Lf narrowly lanceolate; head 5–7 mm wide; gland above petiole base not obvious, < 1 mm wide. .... *[A. longifolia]*
- 10'. Lf linear to narrowly elliptic; head 8–12 mm wide; gland above petiole base obvious, 1–2 mm wide. .... *[A. saligna]*
- 8'. Lf with ≥ 2 ± prominent longitudinal veins
11. Fls in spikes

*R. ilicifolia* Kellogg (p. 1167) HOLLYLEAF REDBERRY Shrub < 4 m. ST: bark gray; branches stiff, gen ascending; twigs glabrous to finely hairy. LF: evergreen; petiole 2–10 mm; blade 20–40 mm, ovate to round, thick, glabrous adaxially, glabrous or hairy, flat to concave abaxially, base rounded, tip obtuse, rounded, or widely notched, margin entire, irregularly toothed, or prickly, veins prominent or not. INFL: 1–6-flld, gen glabrous; pedicel 2–4 mm. FL: gen unisexual; hypanthium ± 2 mm wide; sepals 4; petals 0. FR: 2-stoned, 4–8 mm, red. 2n=24. Chaparral, desert scrub, montane forest; < 1150 m. CA-FP, DMtns; s OR, AZ, Baja CA. Intermediates between *R. ilicifolia*, *R. insula* Kellogg (Baja CA) in PR. Mar–Jun

*R. pilosa* (Curran) Abrams (p. 1167) Shrub, < 2 m. ST: bark gray; branches few, gen flexible, gen ascending; twigs densely hairy. LF: evergreen; petiole 2–5 mm, hairy; blade 15–20 mm, ovate to round,

thick, soft-hairy, abaxially flat to concave, base, tip rounded to acute, margin finely toothed, flat to rolled under, veins not prominent. INFL: 1–6-flld, soft-hairy; pedicel 2–4 mm. FL: gen unisexual; hypanthium ± 2 mm wide; sepals 4; petals 0, 4. FR: 2-stoned, 6 mm, red. Uncommon. Chaparral; 75–1650 m. s PR (San Diego Co.). Jan–Mar

*R. pirifolia* Greene (p. 1167) ISLAND REDBERRY Small tree, < 10 m. ST: bark gray; branches ascending; twigs purple. LF: evergreen; petiole 5–10 mm; blade 20–50 mm, elliptic, thick, glabrous, abaxially concave, base rounded, tip acute to rounded, mucronate, margin entire to toothed, veins prominent. INFL: 1–6-flld, glabrous; pedicels 3–6 mm. FL: gen unisexual; hypanthium ± 2 mm wide; sepals 4; petals 0. FR: 2-stoned, 6–8 mm, red. Coastal-sage scrub, chaparral; 10–520 m. Chi; Mex (Guadalupe Island). Jan–Apr ★

## ZIZIPHUS

Tree, shrub [vine]. ST: branches alternate, flexible or stiff, ± 2–3-ranked; shoots or not, deciduous or not, petioled; stipules ± spine-like or not, unequal; blade elliptic to obovate, ± entire to serrate, 1–5-ribbed from base. INFL: cyme or small panicle. FL: hypanthium surrounding base of ovary; sepals 5; petals 5, < 2 to > 2-lobed. FR: drupe, stone 1. 100 spp.: gen trop. (Latin: from Arabic "zizouf", common jujube, *Ziziphus zizyphus*) [Islam & Simmons 2006 Syst Bot 31:826–842]

1. Tree, lvs ≥ 25 mm, blade shiny adaxially ..... *Z. zizyphus*
- 1' Shrub; lvs ≤ 25 mm, blade not shiny adaxially
2. Fr 7–10 mm, blue-black, not beaked ..... *Z. obtusifolia* var. *canescens*
- 2' Fr 10–25 mm, brown, beaked ..... *Z. parryi* var. *parryi*

*Z. obtusifolia* (Torr. & A. Gray) A. Gray var. *canescens* (A. Gray) M.C. Johnst. (p. 1173) GRAYTHORN Shrub, < 3 m. ST: bark gray, smooth; twigs 1–8 cm, stiff, spreading, thorn-tipped, densely short-white-hairy. LF: deciduous; stipules brown; blade 2–20 mm, ovate or oblong, firm, dull gray, margin entire or teeth 2–10, glandular. INFL: 2–30-flld. FL: hypanthium 1.5–2 mm wide, olive-green, glabrous to tomentose; sepals ± yellow to ± orange or ± purple; petals white; pistil olive-green. FR: fleshy, 7–10 mm, not beaked, blue-black. Uncommon. Desert scrub; 45–1250 m. D; AZ, NV, UT, Mex. 1 other var., in NM, OK, TX, Mex. Apr–Jun

*Z. parryi* Torr. var. *parryi* (p. 1173) PARRY'S JUJUBE Shrub, < 4 m. ST: bark gray to brown, smooth; branches pale green-yellow to ± purple; twigs 1.3–3 cm, stiff, spreading, thorn-tipped, with 1 node, 1 short-shoot, glabrous. LF: deciduous, membranous; stip-

ules brown; blade 10–25 mm, elliptic to obovate, dull olive-green, margin ± entire. INFL: 2–4-flld. FL: hypanthium 2–2.2 mm wide, purple-green, glabrous; sepals green; petals white; pistil green. FR: dry, 10–25 mm, beaked, brown. Uncommon. Chaparral; 15–1220 m. SCo, SnBr, PR, DMoj, w edge DSON; Mex. 1 other var., in Baja CA incl Cedros Island. Feb–Apr

*Z. zizyphus* (L.) H. Karst. JUJUBE Tree, < 12 m. ST: bark gray to black, shaggy; twigs pendent, zigzag. LF: deciduous; blade 25–60 mm, elliptic to obovate, ± leathery, bright green, shiny adaxially, paler, dull abaxially, margin serrate. INFL: 2–8-flld clusters at nodes on twigs. FL: hypanthium 2–2.2 mm wide, green; sepals < petals, both yellow; stamens < petals; pistil green. FR: Fleshy, red. Occ garden escape; 270 m. n SNF, n ScV; US, Old World. [*Z. jujuba* Mill.] Correct name could become *Z. jujuba* Mill. May–Jul

## ROSACEAE

Daniel Potter & Barbara Ertter, family description, key to genera;  
treatment of genera by Daniel Potter, except as noted

Ann to tree, glandular or not. LF: simple to palmately or pinnately compound, gen alternate; stipules free to fused (0), persistent to deciduous. INFL: cyme, raceme, panicle, cluster, or fls 1; bractlets on pedicel ("pedicel bractlets") gen 0–3(many), subtended by bract or gen not. FL: gen bisexual, radial; hypanthium free or fused to ovary, saucer- to funnel-shaped, subtended by bract or gen not. 110 genera, ± 3000 spp.: worldwide, esp temp; many cult for orn, fr, esp *Cotoneaster*, *Fragaria*, *Malus*, *Prunus*, *Pyracantha*, *Rosa*, *Rubus*. Number of teeth is per lf or lflet, not per side of lf or lflet, exc in *Drymocallis*. [Potter et al. 2007 Pl Syst Evol 266:5–43] Scientific Editors: Daniel Potter, Thomas J. Rosatti.

1. Ann to per
2. Pl 1–2 m; lvs 2–3-pinnately compound; fls unisexual; fr follicles ..... *ARUNCUS*
- 2' Pl gen < 1 m; lvs simple to 1-ternately or 1-palmately or 1-pinnately compound, incl 2-ternately dissected; fls gen bisexual; fr achenes or follicles
  3. Petals 0, sepals gen 4; frs 1(3) per fl, inside ± urn-shaped hypanthium ..... *APHANES*
  4. Lf palmately lobed; infl few-flld cluster, axillary, ± hidden by sheathing stipules; hypanthium not hardened in fr; ann. ....

- 4' Lf pinnately compound; infl head or spike, axillary or terminal, not hidden; hypanthium ± hardened in fr; gen per ..... *ACAENA*
5. Hypanthium ± prickly, not angled in fr; stamens 2 or 4 ..... *POTERIDIUM*
- 5' Hypanthium not prickly, 4-angled in fr; stamens 0-many ..... *POTERIUM*
6. Lflets lobed > 2/3 to midvein; ann, bien; basal lvs withered at fl ..... *SANGUISORBA*
- 6' Lflets toothed < 1/3 to midvein; per; basal lvs not withered at fl ..... *POTERIUM*
7. Largest lflet blade gen 5–20 mm, on stalk gen 1–4 mm, teeth gen < 15; stamens many, filaments thread-like; open, esp disturbed areas; CA-FP (exc SNH) ..... *POTERIUM*
- 7' Largest lflet blade 25–50 mm, on stalk 3–25 mm, teeth gen > 15; stamens 2–4, filaments not thread-like; bogs, streams; c NCo, nw KR, n NCoRO ..... *SANGUISORBA*
- 3' Petals, sepals gen 5; fls 1–many per fl, on or outside shallow to ± obconic hypanthium ..... *LUETKEA*
8. St long-trailing to decumbent; lvs ternately dissected, segments linear ..... *AGRIMONIA*
- 8' St gen ascending to erect (prostrate in some *Rubus*); lvs simple to compound, not ternately dissected ..... *RUBUS*
9. Hypanthium obconic to cup-shaped, rim with hooked bristles; infl ± raceme ..... *RUBUS*
- 9' Hypanthium gen shallower than obconic to cup-shaped, rim without hooked bristles; infl gen cyme or fls 1 ..... *GEUM*
10. Hypanthium bractlets 0; achenes fleshy-coated, finely hairy ..... *FRAGARIA*
- 10' Hypanthium bractlets gen present; achenes not fleshy-coated, gen glabrous (exc *Geum*) ..... *DUCHESNEA*
11. Style continuous to fr, if not or inconspicuously hooked then plumose — lvs 1-pinnately compound ..... *POTENTILLA*
- 11' Style jointed to fr, not hooked, not hairy ..... *SIBBALDIA*
12. Lf (sub)palmately to ternately compound ..... *COMARUM*
13. Receptacle in fr strawberry-like (enlarged, red, fleshy); stolons gen present; petals white or yellow; lvs ternately compound ..... *DRYMOCALLIS*
14. Petals yellow; fls 1 from axils of lvs on stolons; hypanthium bractlets gen wider than sepals ..... *HORKELIA*
- 14' Petals gen white; fls 1–several from axils of basal lvs, stolons lfless; hypanthium bractlets narrower than sepals ..... *HORKELIELLA*
- 13' Receptacle in fr not strawberry-like; stolons 0; petals ± yellow; lvs pinnately, palmately, or ternately compound ..... *HORKELIELLA*
15. Stamens 5; petals ± 1 mm; lflets 3, gen 3-toothed at tip ..... *IVESIA*
- 15' Stamens 10–25; petals (2)4–20 mm; lflets 3–7, gen > 3-toothed ..... *POTENTILLA*
- 12' Lf ± 1-pinnately to subpalmately compound ..... *IVESIA*
16. Petals dark red, elliptic to ± ovate, << sepals ..... *IVESIA*
- 16' Petals yellow to white, elliptic to obcordate (linear), < to > sepals ..... *IVESIA*
17. Style fusiform, attached below fr middle ..... *IVESIA*
- 17' Style slender throughout or widest near base, gen attached below fr tip ..... *IVESIA*
18. Hypanthium cup-like, ± flat-bottomed; filaments gen ± flat, often forming tube; petals white or ± pink ..... *IVESIA*
19. Stamens 10; lflets 2–15 per side; CA-FP, GB ..... *IVESIA*
- 19' Stamens 20; lflets 15–35 per side; c&s SNH, SNE ..... *IVESIA*
- 18' Hypanthium ± shallow, if cup-like, not flat-bottomed; filaments gen thread-like, not flat (exc ± flat in *Ivesia argyrocoma* var. *argyrocoma*) ..... *IVESIA*
20. Pl gen hanging clump or rosette in vertical rock crevices, not forming tube; petals white to yellow ..... *IVESIA*
- 20' Pl not hanging clump or rosette, gen not in vertical rock crevices, resin-scented or not ..... *IVESIA*
21. Lf gen ± cylindric; lflets 4–80 per side; pistils 1–8(20); stamens 5–20(40); petals 1–5(7) mm, linear to obovate or round ..... *IVESIA*
- 21' Lf gen ± flat; lflets 2–8(13) per side; pistils gen > 10; stamens 20–25; petals (2)4–20 mm, gen ± widely obcordate ..... *POTENTILLA*
- 1' Subshrub to tree ..... *SORBUS*
22. Lvs deeply lobed (gen to midrib) or compound ..... *DASIPHORA*
23. Ovary gen inferior, chambers 1–5; styles 1–5; fr pome ..... *FALLUGIA*
- 23' Ovary superior, chamber 1; style 1; fr achene or follicle ..... *RUBUS*
24. Pistils gen 10–many ..... *RUBUS*
25. Petals yellow; hypanthium bractlets 5; style attached near fr base ..... *RUBUS*
- 25' Petals white to red; hypanthium bractlets 0 (5 in *Fallugia*); style attached at fr tip ..... *RUBUS*
26. Pl not prickly; lvs pinnately lobed, rusty-scaly abaxially, margins rolled under; style plumose in fr; e DMtns. ..... *FALLUGIA*
- 26' Pl gen prickly; lvs pinnately to palmately compound, not rusty-scaly, margins not gen rolled under; style short-hairy to ± glabrous in fr; gen CA-FP, GB ..... *RUBUS*
27. Lvs pinnately compound; hypanthium urn-shaped; fr not on spongy receptacle, gen enclosed in fleshy hypanthium ..... *RUBUS*
- 27' Lvs palmate-lobed or -compound; hypanthium flat to saucer-shaped; fr on spongy receptacle, not enclosed by hypanthium (aggregate raspberry- or blackberry-like) ..... *RUBUS*
- 24' Pistils 1–6 ..... *LYONOTHAMNUS*
28. Lvs opposite; 1° lflets 5–14 cm; infl gen flat-topped; trunk bark peeling in strips; ChI. ..... *PURSHIA*
- 28' Lvs alternate or clustered; 1° lflets or lobes gen < 5 cm; infl not flat-topped; trunk bark gen not peeling in strips; mainland ..... *PURSHIA*
29. Lf 3–9-lobed; infl gen 1-fl; styles in fr 2–6 cm, plumose ..... *PURSHIA*

- 29' Lf (1)2-3-pinnate- or -ternate-dissected or -compound; infl raceme or panicle; styles in fr gen << 1  
cm, not plumose ..... <sup>2</sup>LUETKEA
30. St ± prostrate to decumbent; pl < 2 dm; lvs ternately dissected, not glandular, not strong-smelling ..... CHAMAEBATIA
- 30' St ascending to erect; pl > 2 dm; lvs pinnately compound, glandular, strong-smelling ..... CHAMAEBATIARIA
31. Pistil 1(2); ovule 1; fr achene; lvs 2-3-pinnately compound ..... CHAMAEBATIARIA
- 31' Pistils 4-5; ovules gen ≥ 2; fr follicle; lvs (1)2-pinnately compound ..... CHAMAEBATIARIA
- 22' Lvs simple, lobed (deeply so only in *Crataegus monogyna*) or unlobed  
32. Ovary inferior or 1/2-inferior, chambers gen 2-5; fr a pome with gen papery core, occ drupe-like  
with 1-5 stones ..... CRATAEGUS
33. St armed with thorns ..... PYRACANTHA
34. Lvs ± ovate, deciduous, gen ± lobed above middle, toothed; larger lvs > 3 cm wide; fr red to black  
34' Lvs gen oblanceolate, narrowly oblong, narrowly obovate, or narrowly elliptic, ± evergreen, unlobed,  
entire to toothed; larger lvs < 2.5 cm wide; fr orange to red ..... PYRACANTHA
- 33' St gen not armed (thorny or not in *Malus*, *Pyrus*) ..... HETEROMELES
35. Lf gen sharp-toothed ..... MALUS
36. Infl many-fld panicle; petals < 4 mm; fr 5-10 mm diam ..... PYRUS
- 36' Infl few-fld cluster; petals 10-15 mm; fr ≥ 10 mm diam ..... PYRUS
37. Fr gen ± spheric, flesh not gritty ..... PERAPHYLLUM
- 37' Fr gen ± obovoid, flesh gritty ..... AMELANCHIER
- 35' Lf entire, minute-gland-toothed, or above middle toothed  
38. Lvs ± clustered on short-shoots, petiole ± 0 ..... COTONEASTER
- 38' Lvs evenly distributed on branches, twigs, petiole > ± 0  
39. Lvs gen serrate above middle, deciduous; fr a pome of 2-5 papery segments, gen blue-black  
39' Lvs entire, deciduous, or evergreen; fr a pome, drupe-like with 2-5 stones, orange to red ..... COTONEASTER
- 32' Ovary superior (sometimes hidden in funnel- or urn-shaped hypanthium), chamber gen 1; fr not a pome  
40. Lf veins palmate  
41. Lf blade 3(5)-lobed above middle, gen wedge-shaped, margin not toothed, rolled under; fls 1 ..... <sup>4</sup>PURSHIA
- 41' Lf blade gen 3-7-lobed below middle, not wedge-shaped, margin ± toothed, ± flat; fls in cluster of  
several to many ..... PHYSOCARPUS
42. Petals 2.5-3 mm; pistils 1-5 (if 3-5, fused below middle); infl umbel-like cluster, not flat-topped;  
fr follicles ..... RUBUS
- 42' Petals 4-30 mm; pistils 5-150; infl raceme- or panicle-like cyme, ± flat-topped; fr fleshy-coated  
achenes (aggregate ± raspberry-like) ..... RUBUS
- 40' Lf veins pinnate  
43. Pl matted, scapose; rosettes many — gen on limestone ..... PETROPHYTUM
- 43' Erect shrub or tree, not scapose; rosettes 0 ..... COLEOGYNE
44. Lvs opposite or in opposite clusters  
45. Shrub 2-20 dm; petals 0 (1-5); pistil 1(2); fr achene; SNE, D (esp DMtns) ..... LYONOTHAMNUS
- 45' Tree 40-150 dm; petals 5; pistils 2; fr follicle; ChI ..... LYONOTHAMNUS
- 44' Lvs alternate or in alternate clusters  
46. Pistil gen 1 ..... PRUNUS
47. Hypanthium cup- to urn-shaped, deciduous in fr; style not tapered to stigma; fr drupe  
fr achene or achene-like ..... PRUNUS
- 47' Hypanthium ± funnel-shaped to obconic, persistent in, ± enclosing fr; style tapered to stigma;  
fr achene or achene-like ..... ADENOSTOMA
48. Hypanthium 0.6-3.2 mm; petals 1.5-2.5 mm; infl many-fld panicle; lf linear to oblanceolate or  
sickle-shaped, margin not rolled under ..... CERCOCARPUS
- 48' Hypanthium 2-14 mm; petals 0 or 6-8 mm; infl 1-18-fld cluster; lf linear to round, margin  
gen rolled under ..... PURSHIA
49. Petals 0; lf toothed or not, lobes 0 ..... OEMLERIA
- 49' Petals 6-8 mm, white to cream; lf gen not toothed, lobes 3-9 ..... PURSHIA
- 46' Pistils gen 2-6  
50. Lf gen entire; infl raceme, pendent; fls unisexual, occ bisexual; fr drupes ..... NEVIUSIA
- 50' Lf lobed or toothed; infl umbel-like cluster, panicle, or fl 1, spreading to erect; fls bisexual;  
fr achenes or follicles ..... SPIRAEA
51. Lf gen widest above middle, margins with 3-9 lobes, gen 0 teeth, ± strongly rolled under;  
fls 1 ..... HOLODISCUS
- 51' Lf gen widest at or below middle, margins with ± 0 lobes, gen with teeth, not rolled under;  
fls gen 3-many ..... SPIRAEA
52. Infl umbel-like cluster, fls gen 3-5; petals 4-6 mm; stamens ± 50, sepals ± toothed ..... NEVIUSIA
- 52' Infl raceme or panicle, fls many; petals 1.5-2 mm; stamens gen < 50, sepals not toothed ..... SPIRAEA
53. Petals gen white; hypanthium saucer-shaped; stigma ± 2-lobed; fr 5 achenes ..... HOLODISCUS
- 53' Petals pink to rose; hypanthium obconic to bell-shaped; stigma head-like; fr 5 follicles ..... SPIRAEA

1. Perianth white to cream; spur gen  $\geq 1.5 \times$  lip ..... *P. dilatata* var. *leucostachys*
- 1' Perianth green to yellow-green; spur < $\ll$  to  $\pm >$  lip ..... *P. dilatata* var. *leucostachys*
2. Column gen 2.5–4 mm,  $\pm 2/3$  hood formed by upper sepal, lateral petals; lip linear to lance-linear ..... *P. sparsiflora*
- 2' Column gen 1.5–2 mm,  $\leq \pm 1/2$  hood formed by upper sepal, lateral petals; lip wider than lance-linear ..... *P. sparsiflora*
3. Spur gen cylindric,  $\pm$  curved — lip lanceolate to oblong or linear-oblong, green-yellow to yellow; lvs clustered near base ..... *P. tescannis*
- 3' Spur club- to sac-like ..... *P. stricta*
4. Lip linear to lanceolate, green, red-marked or not; lvs not clustered ..... *P. tescannis*
- 4' Lip gen lance-rhombic, yellow, not red-marked; lvs clustered below ..... *P. stricta*
- P. dilatata* (Pursh) L.C. Beck var. *leucostachys* (Lindl.) Luer (p. 1407) WHITE-FLOWERED BOG-ORCHID Pl 15–150 cm. LF: 5–35 cm, 9–30 mm wide. INFL: 5–35 cm, gen dense; lower bracts 9–25 mm. FL: perianth white to cream; sepals 4–8 mm; lip 5–10 mm,  $\pm$  lanceolate, spur 5–15 mm, gen  $\geq 1.5 \times$  lip, gen cylindric,  $\pm$  curved; column gen  $< 1/2$  hood formed by upper sepal, petals. 2n=42. Wet, gen open places, meadows, seeps, streambanks; < 3400 m. CA-FP (exc GV), GB, n DMts (Panamint Range); to AK, MT, UT, NV. [P. l. Lindl.] Hybridizes with *P. sparsiflora* (*P. × lassennii* W.J. Schrenk), *P. stricta* (*P. × estesii* W.J. Schrenk), *P. tescannis* (unnamed). May–Sep
- P. sparsiflora* (S. Watson) Schltr. (p. 1407) SPARSE-FLOWERED BOG-ORCHID Pl 25–55 cm. LF: 4–15 cm, 5–30 mm wide. INFL: gen 15–40 cm, dense to  $\pm$  open, lowest fls gen not overlapping. FL: perianth yellow-green to green; sepals 5–9 mm; lip 6–10 mm, linear to lance-linear, spur  $\pm$  = lip,  $\pm$  cylindric,  $\pm$  curved, tip acute; column gen 2.5–4 mm. 2n=42. Full sun to partial shade, wet meadows, streambanks, seeps, conifer forest; 100–3400 m. NW (exc NCoRI), CaR, SN, SCo, TR, MP, D; to OR, UT, NM, Baja CA. May–Sep
- P. stricta* Lindl. (p. 1407) SLENDER BOG-ORCHID Pl 20–90 cm. LF: 4–11 cm, 5–25 mm wide, oblong to ovate, evenly spaced. INFL: 5–22 cm, gen open below; lower bracts 5–35 mm. FL: perianth gen green to yellow-green; sepals 3–6 mm, lance-elliptic, twisted,  $\pm$  reflexed; lateral petals lance-elliptic, lip  $\pm$  pendent, 5–7 mm, linear to lanceolate, green, red-marked or not, spur 0.5–1  $\times$  lip, pendent, club- to sac-like, tip blunt, tinged red- $\pm$  purple or not; column  $\pm$  2 mm,  $\leq \pm 1/2$  hood formed by upper sepal, petals. 2n=42. Full sun to part shade, wet meadows, seeps, conifer forest; 1000–2300 m. KR, CaR, MP; to AK, MT, WY. May–Sep ★
- P. tescannis* Sheviak & W.F. Jenn. Pl 29–126 cm. LF: 4–9, clustered near base, 8–29 cm, 8–50 mm wide, to lance-linear to -elliptic to ovate. INFL: 15–61 cm, open to dense. FL: sepals 2.7–5 mm, lanceolate, green; petals 4.5–8 mm, sickle-shaped, forming hood with upper sepal, lip  $\pm$  pendent, gen lanceolate to oblong or linear-oblong, green-yellow to yellow, spur 0.8–1.4  $\times$  lip, gen cylindric,  $\pm$  curved, tip subacute; column  $\leq \pm 1/2$  hood formed by upper sepal, petals. 2n=42. Mesic canyons, woodland edge, dry slopes, conifer forest; 1825–2950 m. SN, GB; to CO, AZ. [P. hyperborea (L.) Lindl., misappl.] Jun–Aug
- P. yosemitensis* Colwell et al. YOSEMITE BOG-ORCHID Pl 20–80 cm. LF: 5–7, clustered below, 9–25 cm, 1.5–3 cm wide, lanceolate, tip acute. FL: strongly pungent; sepals green, upper ovate, lateral oblong; petals 3–4 mm,  $\pm$  yellow, ovate-deltoid, forming hood with upper sepal, lip 4–6 mm, gen lance-rhombic, often upturned, yellow, spur sac-like, 2–28 mm; column  $\leq \pm 1/2$  hood formed by upper sepal, petals, rounded, anther sacc gen parallel. FR: capsule, 0.3–1 cm. 2n=42. Wet meadows; 2100–2285 m. c SNH (Yosemite National Park). Jul–Aug ★

## SPIRANTHES LADIES TRESSES

LF: at fl 0 or  $\pm$  basal. INFL: spike, gen dense, fls in spiral; bracts lf-like, < to  $>$  fls, gradually reduced upward, linear to oblong. FL: sepals, lateral petals narrow-lanceolate; upper sepal  $\pm$  fused to lateral petals, together hood-like, enclosing column, lower  $\pm$  free,  $\pm$  = lip, adherent to hood; lip not spurred, pouch-like, deeply grooved below middle, concave above; column  $<$  lip, tip with anther on back. FR: spreading to ascending.  $\pm$  40 spp.: esp Am, also Japan, Australia, New Zealand. (Greek: coiled fls) Pls in SN may be hybrids between spp. below, for which *S. stellata* P.M. Brown et al. might be correct.

1. Lip lanceolate to  $\pm$  ovate, tip puberulent above; perianth  $\pm$  yellow (cream); upper sepal, lateral petals gen spreading, not forming hood ..... *S. porrifolia*
- 1' Lip  $\pm$  violin-shaped, tip glabrous above; perianth  $\pm$  white (cream); upper sepal, lateral petals forming hood ..... *S. romanzoffiana*

*S. porrifolia* Lindl. (p. 1407) Pl 18–56 cm. LF: basal 8–14 cm. INFL: 5–14 cm; fl bracts 7–20 mm. FL: sepals, petals 7–12 mm; column 2–4 mm. 2n=44[66]. Wet meadows, freshwater marshes, seeps; < 2500 m. NW (exc NCoRI), CaR, SN, n CCo, SnFrB, SCoRO, SnGb, PR; to WA. Jun–Sep

*S. romanzoffiana* Cham. (p. 1407) Pl 7–30 cm. LF: basal 3–13 cm. INFL: 2–14 cm; fl bracts 6–14 mm. FL: sepals, petals 8–12 mm; column 1.5–4 mm. 2n=44, 66, 88. Wet meadows, freshwater marshes, seeps; < 3300 m. NW, CaR, SN, CCo, SnFrB, SnBr, SnJt, MP; to AK, ne N.Am, NM; Eur. May–Sep

## POACEAE (Gramineae) GRASS FAMILY

James P. Smith, Jr., except as noted

Ann to woody per; roots gen fibrous. ST: gen round, hollow; nodes swollen, solid. LF: alternate, 2-ranked, gen linear, parallel-veined; sheath gen open; ligule membranous or hairy, at blade base. INFL: various (of gen many spikelets). SPIKELET: glumes gen 2; florets (lemma, palea, fl) 1–many; lemma gen membranous, sometimes glume-like; palea gen  $\pm$  transparent,  $\pm$  enclosed by lemma. FL: gen bisexual, minute; perianth vestigial; stamens gen 3; stigmas gen 2, gen plumose. FR: grain (rarely achene-like). sugar cane, forage crops, orn, weeds; thatching, weaving, building materials). [Barkworth et al. 2003 FNANM:25; Barkworth et al. 2007 FNANM:24] Gen wind-pollinated. *Achnatherum*, *Ampelodesmos*, *Hesperostipa*, *Nassella*, *Piptatherum*, *Piptochaetium*, *Ptilagrostis* moved to *Stipa*; *Elytrigia*, *Leymus*, *Pascopyrum*, *Pseudoroegneria*, *Taeniatherum* to *Elymus*; *Hierochloe* to *Anthonoxanthum*; *Lolium*, *Vulpia* to *Festuca*; *Lycurus* to *Muhlenbergia*; *Monanthochloe* to *Distichlis*; *Pleuraphis* to *Hilaria*; *Rhynchospora* to *Melinis*. The following taxa (in genera not incl here), recorded in CA from historical collections or reported in literature, are extirpated, lacking vouchers, or not considered naturalized: *Acraea racemosa* (Roth) Ohwi, *Allolepis texana*

(Vasey) Soderstr. & H.F. Decker, *Amphibromus nervosus* (Hook. f.) Baill., *Axonopus affinis* Chase, *A. fissifolius* (Raddi) Kuhlm., *Coix lacryma-jobi* L., *Cutandia memphitica* (Spreng.) K. Richt., *Dinebra retroflexa* (Vahl) Panz., *Eremochloa ciliaris* (L.) Merr., *Eustachys distichophylla* (Lag.) Nees, *Gaudinia fragilis* (L.) P. Beauv., *Misanthus sinensis* Andersson, *Neyraudia arundinacea* (L.) Henrard, *Phyllostachys aurea* Rivière & C. Rivière, *P. bambusoides* Siebold & Zuccarini, *Rottboellia cochinchinensis* (Lour.) Clayton, *Schedonnardus paniculatus* (Nutt.) Branner & Coville, *Schizachyrium cirratum* (Hack.) Wooton & Standl., *S. scoparium* (Michx.) Nash, *Themeda quadrivalvis* (L.) Kuntze, *Thysanolaena latifolia* (Hornem.) Honda, *Tribolium oblitterum* (Hemsl.) Renvoize, *Zea mays* L., *Zizania palustris* L. var. *interior* (Fassett) Dore, *Zoysia japonica* Steud. *Paspalum pubiflorum* E. Fourn., *P. quadrifarium* Lam., are now reported for s CA (J Bot Res Inst Texas 4:761-770). See Glossary p. 30 for illustrations of general family characteristics. Scientific Editors: James P. Smith, Jr., J. Travis Columbus, Dieter H. Wilken.

## [PHYLLOSTACHYS]

1. Lf base constricted to form false petiole; st woody.....

## CENCHRUS

1' Lf base forming open or closed tubular sheath; st gen herbaceous .....

2. Spikelets enclosed in bristly to spiny, bur-like involucre .....

2' Spikelets not enclosed in bristly to spiny, bur-like involucre .....

*Poa bulbosa* subsp. *vivipara*

3. Some or all florets modified into bulblets with conspicuous, awn-like tails .....

## DISTICHLIS

3' Florets not modified into bulblets .....

## SWALLENLIA

4. Lf blades at least upper, gen stiff at maturity, sharp-pointed and conspicuously arranged in 2 vertical rows .....

## NEOSTAPFIA

5. Spikelets unisexual, pls gen dioecious; pls of salt marshes and moist alkaline sites .....

## TUCTORIA

5' Spikelets bisexual; pls known only from sand dunes in Inyo Co. ....

6. Lf blades gen soft, rounded to acute, but not sharp-pointed (exc *Blepharidachne*, *Munroa*), not conspicuously arranged in 2 vertical rows .....

## MELICA

6' Lf blade and sheath undifferentiated; st internodes solid; ligules 0 .....

## ORCUTTIA

7. Spikelets 2-ranked on infl axis .....

7' Spikelets spirally inserted on infl axis .....

8. Pl glandular-sticky at maturity; infl a dense, cylindric spike, gen fully exserted at maturity; spikelets dorsally compressed .....

## ARRHENATHERUM

8' Pl not glandular-sticky at maturity; infl club-shaped, often ± enclosed by lvs at maturity; spikelets laterally compressed .....

9. Lf blade and sheath clearly differentiated; st internodes gen hollow; ligules gen present .....

## DASYOCHLOA

9' Basal or subterranean internodes swollen, bulb- or corm-like .....

10. Infl spike-like, cylindric or ovoid, branches not evident; glumes winged .....

## PHELIUM

10' Infl panicle-like, open with evident branches; glumes not winged .....

11. Sheath open; glumes ± enclosing florets; lower lemma awns bent, twisted .....

## MUNROA

11' Sheath closed to near tip; glumes = lowest floret; lower lemma awns gen 0 or awns straight, untwisted .....

12. Robust per, gen 1.5-7 m; st 0.5-3 cm diam, tough, hardened to woody, gen persisting; infl terminal, often conspicuously plume- or fan-like .....

## BOTHRIOCLOA

12' Low ann to mid-sized per, gen < 1.5 m; st gen < 5 mm wide, strictly herbaceous, gen dying back annually; infl axillary, terminal, or both, but not conspicuously plume- nor fan-like .....

13. Pls gen < 15 cm; mature infl not clearly exceeding lvs, often ± enclosed in upper sheath .....

## ANDROPOGON

14. Floret 1; lemma 1-veined .....

## CRYPYSIS

14' Florets 2+; lemma ≥ 3-veined .....

15. Lemma awn 0 .....

16. Infl subtended by 5-10 bristles; spikelets 1-2 mm; florets 2 .....

## PENNSETUM

16' Infl not subtended by bristles; spikelets 6-10 mm; florets 3-5 .....

## SCLEROCHLOA

15' Lemma awns 1 or 3 .....

17. Lemma 3-lobed, conspicuously ciliate; upper florets 3-awned .....

## BLEPHARIDACHNE

17' Lemma 2-lobed or tapering to awn .....

18. Glumes 6-9 mm, > lemma; lemma 2-lobed .....

## DASYOCHLOA

18' Glumes 2-4 mm, < lemma; lemma tapering to point .....

## MUNROA

13' Pls gen >> 15 cm; mature infl clearly exceeding upper lvs .....

19. Spikelets 1-2 per infl .....

20. Glumes < lowest floret; awns (if present) not twisted, nor bent .....

## BRACHYPODIUM

20' Glumes > lowest floret; awns twisted and bent .....

## DANTHONIA

19' Spikelets few to many in a well-developed infl .....

21. Spikelets subtended by 1+ bristles, sterile branches, or long, silky hairs > spikelet .....

## BOTHRIOCLOA

22. Spikelets subtended by long, silky hairs from their bases, rachis joints, or pedicels .....

## IMPERATA

23. Spikelets dissimilar, sessile bisexual, stalked sterile .....

23' Spikelets similar, bisexual .....

22' Spikelets subtended by 1 or more gen stiff bristles or sterile branches .....

## SETARIA

24. Bristles short-stiff-hairy .....

24' Bristles scabrous to long-ciliate .....

25. Infl panicle-like, branches 2-7 .....

25' Infl spike-like, dense, cylindrical .....

## ANDROPOGON

21' Spikelets not subtended by bristles or by long, silky hairs .....

## PENNSETUM

- Spike  
Model
26. Glume and/or lemma bodies covered with long, silky hairs ..... **LAGURUS**
27. Infl dense, ovoid or oblong, head-like; spikelets 1-fld ..... *Digitaria californica*
- 27' Infl open, branching evident; spikelets 2-fld ..... **MELINIS**
28. Spikelets paired on one side of a slender rachis ..... *Muhlenbergia alopecuroides*
- 28' Spikelets single on ends of short capillary branches ..... *Elymus multisets*
- 26' Glumes and lemma bodies glabrous to short-hairy
29. Glumes or lemma (perhaps only in a unisexual spikelet) with 3–9 awns or awn-like segments (lateral awns sometimes << than central 1) ..... **ENNEAPOGON**
30. Lemma awns 9, plumose ..... *AEGIOPS*
- 30' Lemma awns 0–3, not plumose
31. Lower glume with (2)3–9 awns or awn-like segments ..... *Elymus multisets*
32. Spikelets 1-fld ..... *ARISTIDA*
- 32' Spikelets 2–5 fld
33. Ann; spikelets 1 per node ..... *SCLEROPOGON*
- 33' Per; spikelets 2(3–4) per node ..... *BOUTELOUA*
- 31' Lower glume awn 0 or 1
34. Spikelets 1-fld ..... *HILARIA*
- 34' Spikelets 2–several-fld
35. Infl open, panicle-like; spikelets pistillate ..... *HORDEUM*
- 35' Infl 1–many raceme-like or spike-like 1° branches; spikelets bisexual ..... *Phalaris paradoxa*
- 29' Glume or lemma awns 0–2
36. Spikelets gen dorsally compressed (cylindrical); florets 2, lower sterile or staminate, often reduced to sterile lemma, upper floret bisexual; glume and fertile lemma texture noticeably dissimilar; spikelets breaking apart below the glumes, falling singly or in pairs with segments of infl axis attached ..... **Group 2**
- 36' Spikelets gen laterally compressed or cylindric; florets 1–many, if > 1, lower one(s) gen fertile, upper reduced and sterile; glume and fertile lemma texture gen similar; spikelets gen breaking apart above glumes and between florets or floret clusters
37. Pls bearing markedly dissimilar spikelets in the same or separate infls ..... *SCLEROPOGON*
38. Spikelets unisexual ..... *CYNOSURUS*
- 38' Spikelets bisexual or sterile
39. Infl spike-like
40. St internodes solid; spikelets sessile ..... *LAMARCKIA*
- 40' St internodes hollow; central spikelet sessile, laterals stalked (exc in *Hordeum vulgare*) ..... *HILARIA*
- 39' Infl panicle-like, open to dense
41. Lemma awn 0; spikelets in groups of 7 (1 fertile + 6 sterile) ..... *Phalaris paradoxa*
- 41' Lemma awned; spikelets paired or in pendant clusters
42. Infl panicle-like with drooping clusters of 1 fertile spikelet and 1–3 sterile ones; spikelet clusters falling as 1 unit ..... *POA*
- 42' Infl head-like or cylindric, spikelets gen paired; spikelets falling separately ..... *CYNOSURUS*
- 37' Pls bearing similar spikelets, differing only in size and degree of maturity
43. Spikelets sessile or stalked on an unbranched central axis ..... **Group 3**
- 43' Spikelets attached to 1° or 2° branches (dissection may be needed to reveal branches) ..... **Group 4**
44. Infl a series of 2 or more digitate, raceme-like, clusters, or whorls of 1° branches ..... *ERAGROSTIS*
- 44' Infl much-branched, 2° or 3° branching evident
45. Spikelets 1-fld ..... *ERAGROSTIS*
- 45' Spikelets 2–many-fld (sterile florets reduced to small scales or hairy, awl-like rudiments) ..... *POA*
46. Spikelets 2–8 per node ..... *DISSANTHELIUM*
- 46' Spikelets 1 per node
47. Spikelets unisexual; pls dioecious
48. Lf tips prow-shaped; lemma base with cottony or cobwebby tuft of hairs ..... *ERAGROSTIS*
- 48' Lf tips flat; lemma bases glabrous to scabrous
49. Pls rhizomatous; lemma glabrous, veins 9–11, inconspicuous ..... *ERAGROSTIS*
- 49' Pls densely tufted; lemma scabrous, veins (3)5(7) ..... *ERAGROSTIS*
- 47' Spikelets bisexual
50. Fertile florets 2+ (occ 1 in *Dissanthelium*)
51. Lemma veins gen (3)5–several, sometimes very faint ..... **Group 6**
- 51' Lemma veins 3, gen prominent (laterals sometimes near margins) ..... *DISSANTHELIUM*
52. Glumes > florets; florets 2(3) — ChI ..... *ERAGROSTIS*
- 52' Glumes < upper florets; florets 3–many
53. Lemma veins glabrous
- 53' Lemma veins hairy, at least below
54. Lf blade margin white; lemma awn 0.5–2.5 mm; stigmas white ..... *ERIONEURON*
- 54' Lf blade margin green; lemma awn 0; stigmas purple ..... *TRIDENS*

- 50' Fertile floret 1  
 55. Spikelet breaking below glumes; lower floret bisexual, awn 0; upper floret staminate, awned .....  
 55' Spikelet breaking above glumes; staminate or sterile floret(s) below fertile one (sometimes << fertile and easily overlooked) ..... HOLCUS  
 56. Fertile floret gen awned .....  
 57. Per; nodes green or straw-colored; spikelets breaking apart below lowest floret .....  
 57' Ann; nodes purple-black; spikelets breaking apart above lowest floret ..... <sup>2</sup>ARRHENATHERUM  
 56' Fertile floret awn 0 ..... VENTENATA  
 58. Lower florets reduced to sterile lemma < 1/2 fertile floret .....  
 58' Lower staminate or sterile florets ≥ fertile one ..... PHALARIS  
 59. Spikelets straw-colored or brown at maturity; stamens 2–3; auricles 0 (exc in *Anthoxanthum aristatum*, *A. odoratum*) ..... ANTHOXANTHUM  
 59' Spikelets green or purplish at maturity; stamens 3 or 6; auricles ciliate ..... EHRHARTA

**Group 1**

Robust per; st gen 1.5+ m, 0.5+ cm diam

1. St much-branched above base .....  
 1' St not branched above base (exc infl) ..... [PHYLLOSTACHYS]  
 2. Lvs predominantly basal .....  
 3. St internodes hollow; spikelets unisexual (pls gen pistillate) ..... CORTADERIA  
 3' St internodes solid; spikelets bisexual ..... *Stipa mauritanica*  
 2' Lvs well distributed along sts .....  
 4. Infl branches and spikelets glabrous .....  
 5. Infl spike-like (branched below) ..... *Elymus condensatus*  
 5' Infl panicle-like ..... SORGHUM  
 4' Infl branches and/or spikelets hairy .....  
 6. St internodes solid; spikelets paired, one or both stalked .....  
 7. Spikelets unequally stalked; infl axis remaining intact at maturity ..... IMPERATA  
 7' 1 spikelet sessile, 2nd stalked; infl axis breaking apart at maturity, segments with spikelets attached ..... SACCHARUM  
 6' St internodes hollow; spikelets 1 per node ..... ARUNDO  
 8. Spikelet axis glabrous; lemma densely hairy .....  
 8' Spikelet axis silky-hairy; lemma glabrous ..... PHRAGMITES

**Group 2**

Spikelets dorsally compressed, breaking apart below glumes; glumes and fertile lemma of dissimilar texture

1. Glumes leathery to hardened (at least in sessile spikelets), ± equal, 1 or both gen > upper floret (exc awns); fertile and sterile lemmas gen translucent ..... ANDROPOGON  
 2. Spikelets 1 per node, subtended by a hairy bristle .....  
 2' Spikelets 2 or 3 per node, 1 sessile and 1 (2) stalked ..... SORGHUM  
 3. Terminal spikelets per branch in 3s, 1 sessile and 2 stalked .....  
 3' Terminal spikelets per branch in 2s, 1 sessile and 1 stalked ..... HETEROPOGON  
 4. Infl unbranched, raceme-like .....  
 4' Infl branched, panicle-like .....  
 5. Infl internodes and spikelet stalks with a translucent longitudinal groove; lowest pair of spikelets per raceme fertile ..... *BOTHRIOCLOA*  
 5' Infl internodes and spikelet stalks without a translucent longitudinal groove; lowest pair of spikelets per raceme staminate ..... HYPARRHENIA  
 1' Glumes membranous, flexible, lower glume gen < upper (0), upper glume ≤ upper floret; sterile lemma membranous and resembling upper glume, fertile lemma leathery to hardened (membranous in *Digitaria*) ..... ERIOCHLOA  
 6. Spikelet subtended by a cup- or ring-like structure .....  
 6' Spikelet not subtended by cup- or ring-like structure ..... ECHINOCHLOA  
 7. Ligule 0, at least on upper lvs .....  
 7' Ligule present .....  
 8. Infl a series of digitate or raceme-like branches ..... DIGITARIA  
 9. Fertile floret membranous, flexible at maturity ..... PASPALUM  
 9' Fertile floret leathery to hardened, rigid at maturity .....  
 8' Infl panicle-like .....  
 10. Fertile lemma thin, flexible; lower glume minute or 0 ..... *Digitaria californica* var. *californica*  
 10' Fertile lemma ± thick, rigid; lower glume well-developed ..... PANICUM

**Group 3**

Infl solitary, spike-like or raceme-like; spikelets sessile or stalked

1. Some or all spikelets stalked
2. Spikelets 3 per node, sessile and stalked (or only stalk remaining after upper spikelet has fallen); infl spike-like
  3. St internodes solid; auricles 0; central spikelet short-stalked, laterals sessile; glumes awned ..... *HILARIA*
  - 3' St internodes hollow; auricles present or 0; central spikelet sessile, laterals stalked; glumes awnless ..... *HORDEUM*
- 2' Spikelets 1 per node, stalked; infl raceme-like
  4. Lemma veins prominent, parallel; palea keeled, winged on lower 1/2 ..... *PLEUROPOGON*
  - 4' Lemma veins converging at tip; palea not winged
    5. Glumes  $\geq$  florets,  $\pm$  enclosing them ..... <sup>2</sup>*DANTHONIA*
    - 5' Glumes  $\pm$  = lower florets only
      6. Spikelet axis thickened, falling with florets; lemma  $\pm$  circular in  $\times$ -section ..... *DESMAZERIA*
      - 6' Spikelet axis not thickened, not falling with florets; lemma flattened
      7. Upper lf sheaths closed; lemma tips gen 2-forked or 2-lobed ..... *BROMUS*
      - 7' Upper lf sheaths open; lemma tips obtuse or acute
        8. Upper glume veins (3)5–9; palea keeled, ciliate ..... <sup>2</sup>*BRACHYPODIUM*
        - 8' Upper glume veins 3(5); palea glabrous or hairy, but not keeled, nor ciliate ..... <sup>2</sup>*FESTUCA*
  - 1' All spikelets sessile or nearly so (upper spikelets sometimes stalked in *Scribneria*)
  9. Glume 1 (exc in uppermost spikelets)
    10. St internodes hollow; infl axis remaining intact at maturity; spikelets breaking apart above glumes; lemma veins 5 ..... <sup>2</sup>*FESTUCA*
    - 10' St internodes solid; infl axis breaking apart at maturity, spikelets falling with axis segments; lemma veins 3 ..... *HAINARDIA*
  - 9' Glumes 2
    11. Spikelet bases  $\pm$  embedded in cavities or pits in thickened infl axis
      12. Per from stolons or rhizomes; spikelets attached to one side of flattened infl axis ..... *STENOTAPHRUM*
      - 12' Ann; spikelets attached to both sides of rounded infl axis
      13. Spikelets awnless ..... *PARAPHOLIS*
      - 13' Spikelets awned
        14. Glumes awned; lemmas awnless; florets 2–5 ..... *AEGILOPS*
        - 14' Glumes awnless; lemma awned; floret 1 ..... *SCRIBNERIA*
    - 11' Spikelet bases not embedded in cavities or pits of thickened infl axis
    15. Spikelets borne on one side of infl axis; lemma veins 3 ..... *BOUTELOUA*
    - 15' Spikelets 2-ranked; lemma veins 5–9
    16. Spikelets 2–8 per node
    - 16' Spikelets 1 per node
      17. Lemma keels ciliate ..... *SECALE*
      - 17' Lemma keels (if present) not ciliate
        18. Glumes  $>$  florets and gen enclosing them (exc awns and lemma teeth). ..... <sup>2</sup>*DANTHONIA*
        - 18' Glumes  $<$  florets
          19. Fertile floret 1, subtended by 2 sterile florets ..... *Ehrharta longiflora*
          - 19' Fertile florets 2+, sterile florets above the fertile ones
          20. Auricles 0
          - 20' Auricles present
            21. Glumes and lemma backs rounded ..... <sup>2</sup>*ELYMUS*
            - 21' Glumes and lemmas keeled
              22. Per; lemma awns 1–6 mm ..... *AGROPYRON*
              - 22' Ann; lemma awns to (0)4 cm ..... *TRITICUM*

**Group 4**

Infl branches digitate, raceme-like, clustered, or in whorls; no further branching evident

1. Infl branches digitate or clustered at tip of infl axis
2. Glume and lemma awns 0
  3. Per; floret 1; internal spikelet axis extended behind palea as a slender bristle, rarely bearing a sterile floret ..... *CYNODON*
  - 3' Ann or short-lived per; florets 2+; internal spikelet axis not extended behind palea ..... *ELEUSINE*
  - 2' Glumes and/or lemmas awned
  4. Spikelets laterally compressed or cylindric, but not keeled; upper glume awn 0; tip of infl branch not extending beyond last spikelet ..... <sup>2</sup>*CHLORIS*
  - 4' Spikelets strongly keeled; upper glume awned; tip of infl branch extending beyond last spikelet
    - 1' Infl branches raceme-like, 1+ per node along a central, unbranched axis, or in whorls ..... *DACTYLOCTENIUM*
    5. Floret 1 per spikelet; pls of coastal marshes and wet places ..... *SPARTINA*

- 5' Florets 2+ per spikelet (exc basal spikelet)  
 6. Fertile floret 1 per spikelet  
 7. Infl branches 2+ per node . . . . .  
 7' Infl branches 1 per node . . . . .  
 8. Spikelet laterally compressed; lowest floret bisexual . . . . . <sup>2</sup>**CHLORIS**  
 8' Spikelet dorsally compressed; upper floret bisexual . . . . .  
 6' Fertile florets 2+ per spikelet . . . . . **BOUTELOUA**  
 9. Lemma 3-veined, sometimes appearing 1-veined . . . . . **ECHINOCHLOA**  
 9' Lemma 5-several-veined . . . . .  
 10. Upper glume 3-veined . . . . . **LEPTOCHLOA**  
 10' Upper glume 7-veined . . . . . **FESTUCA**  
**SCLEROCHLOA**

**Group 5**

Infl panicle-like, open and spreading to compact, cylindrical or head-like; spikelets 1-fld

1. St nodes purple-black; floret staminate . . . . . **VENTENATA**  
 1' St nodes green or straw-colored; floret bisexual . . . . .  
 2. Glumes 0; palea 3-veined; pls of wet sites . . . . . **LEERSIA**  
 2' Glumes 1 or 2; palea, when present, 2-veined; pls gen of drier sites (exc *Oryza* and some *Phalaris*) . . . . .  
 3. Lower glume awns 2 . . . . . *Muhlenbergia alopecuroides*  
 3' Lower glume awn 0 or 1 . . . . .  
 4. Spikelets ± round, overlapping in 2 rows on 1 side of infl branch; glumes winged, body transversely wrinkled . . . . . **BECKMANNIA**  
 4' Spikelets not round, nor overlapping in 2 rows; glumes not winged, body smooth or veined, but not transversely wrinkled . . . . .  
 5. Glumes ciliate-keeled . . . . .  
 6. Glumes united at base; lemma awned; palea 0 . . . . . **ALOPECURUS**  
 6' Glumes separate at base; lemma awnless; palea present . . . . . **PHLEUM**  
 5' Glumes glabrous to sparsely hairy, but not ciliate-keeled . . . . .  
 7. Glumes unequal, tapering to a long point, ± swollen at base . . . . . **GASTRIDIUM**  
 7' Glumes equal or unequal, but not tapering to long points, not swollen at base . . . . .  
 8. Glumes keeled, often winged; floret subtended by a membranous flap or tuft of hairs . . . . . **PHALARIS**  
 8' Glumes gen rounded, not winged; floret not subtended by a flap or tuft of hairs . . . . .  
 9. Lemma gen hardened at maturity, margins gen overlapping and enclosing palea and grain; grain hardened, round in ×-section; callus well-developed, blunt or sharp-pointed . . . . .  
 10. St internodes ± solid; lemma veins 3, awns gen straight; ligule of hairs or basal membrane long-ciliate . . . . . **ARISTIDA**  
 10' St internodes hollow; lemma veins 3-7, awns gen bent 1-2 ×; ligule gen membranous . . . . . **STIPA**  
 9' Lemma and grain membranous or firm, but not hardened, gen flattened; callus not esp well-developed . . . . .  
 11. Spikelet axis extended beside or above floret as a glabrous or hairy stub or bristle . . . . . **CINNA**  
 12. Spikelets breaking apart below glumes at maturity; stamens 1-2 . . . . .  
 12' Spikelets breaking apart above glumes at maturity; stamens 3 . . . . . **APERA**  
 13. Ann; callus glabrous to sparsely hairy . . . . .  
 13' Ann or per from stolons or rhizomes; callus hairy . . . . . **AMMOPHILA**  
 14. Infl dense, cylindrical; spikelets 12-14 mm; lemma awn 0 . . . . . **CALAMAGROSTIS**  
 14' Infl open, panicle-like; spikelets 2-4(11) mm; lemma awn 0.5-17 mm . . . . .  
 11' Spikelet axis not extended beside or above floret . . . . . **ORYZA**  
 15. Pls of flooded fields and in adjacent ditches; stamens 6 . . . . .  
 15' Pls terrestrial; stamens 1 or 3 . . . . .  
 16. Glumes with well-developed awns (exc *Polypogon viridis*); spikelets breaking apart below glumes . . . . . **POLYPOGON**  
 16' Glumes acute, acuminate, or awn-tipped; spikelets breaking apart above glumes . . . . . **SPOROBOLUS**  
 17. Lemma vein 1, awn 0; lf sheaths gen ciliate at tip; seed ejected from grain at maturity . . . . .  
 17' Lemma vein 3 or 5, awn present or 0; lf sheaths not ciliate at tip; seed remaining within grain at maturity . . . . . **AGROSTIS**  
 18. Lemma veins 5(3), faint; palea gen 0 or << lemma . . . . . **MUHLENBERGIA**  
 18' Lemma veins 3, gen obvious; palea gen well-developed . . . . .

**Group 6**

Infl panicle-like, open and spreading to compact, cylindrical or head-like; fertile florets 2+

- Infl panicle-like, open and spreading to compact, cylindrical or head-like; fertile florets 2+
1. One or both glumes ≥ lowest floret, sometimes enclosing all of them . . . . . **BRIZA**  
 2. Spikelet length ± = width; glumes, lemma papery to translucent, inflated, at right angles to spikelet axis . . . . .  
 2' Spikelet longer than wide; glumes, lemma not papery to translucent, nor at right angles to axis . . . . . **SPHENOPHOLIS**  
 3. Glumes of 2 kinds, lower linear to lanceolate, upper 3-4× wider than lower when spread flat; spikelet axis breaking below glumes . . . . .

- 3' Glumes similar in shape, equal in length or not; spikelets breaking above glumes and between florets (exc *Trisetum*)
4. Lemma awnless
5. Spikelet axis extended beyond bisexual florets as a slender, hairy bristle, sometimes with a reduced floret at its tip
6. Spikelets shiny; glume keels minutely ciliate; axis internodes < 1 mm ..... <sup>2</sup>**KOELERIA**
- 6' Spikelets not shiny; glume keels not ciliate; axis internodes 1.5–2 mm ..... <sup>3</sup>**TRISETUM**
- 5' Spikelet axis not extended beyond bisexual florets
7. Per; palea veins swollen at base; spikelets 7–15 mm ..... [*Danthonia decumbens*]
- 7' Ann; palea veins not swollen at base; spikelets 4.5–7 mm ..... **SCHISMUS**
- 4' Lemma awned
8. Spikelets 15–50 mm ..... **AVENA**
- 8' Spikelets < 15(20) mm
9. Lemma awned at or below middle
10. Ann; lemma tip 2-lobed; spikelet axis not extended beyond upper floret ..... **AIRA**
- 10' Per (exc *Deschampsia danthonioides*); lemma tip 2–4 toothed at truncate tip; spikelet axis gen extended beyond upper floret
11. Lvs gen basal, blades 1–3 mm wide; spikelet axis  $\geq 0.75$  mm beyond upper floret, gen densely hairy ..... **DESCHAMPSIA**
- 11' Lvs gen caudine, blades 3–7 mm wide; spikelet axis inconspicuous beyond upper floret,  $\pm 0.5$  mm, gen glabrous ..... **VAHLODEA**
- 9' Lemma awned at or near tip or between 2 teeth
12. Spikelet axis clearly hairy ..... <sup>3</sup>**TRISETUM**
- 12' Spikelet axis  $\pm$  glabrous
13. Lemma hairy, hairs in 1+ transverse rows ..... **RYTIDOSPERMA**
- 13' Lemma glabrous or if hairy, hairs on margins or evenly distributed ..... **DANTHONIA**
- 1' Lower glume < lowest floret, never enclosing 2 or more florets
14. Lemma awnless
15. Lemma veins  $\pm$  prominent, equally-spaced, parallel
16. Upper glume 1-veined; lf sheath closed to near top ..... **GLYCERIA**
- 16' Upper glume 3-veined; lf sheath open
17. Rhizomes 0; lemma faintly 5-veined; pls of saline or alkaline soils ..... **PUCCINELLIA**
- 17' Rhizomes present; lemma distinctly 7–9-veined; pls of freshwater sites ..... **TORREYOCHELOA**
- 15' Lemma veins not esp prominent, converging at tip
18. Lf tips pro-w-shaped; callus and/or lemma base gen cobwebby-hairy ..... **POA**
- 18' Lf tips flat; callus or lemma base glabrous to scabrous
19. Spikelet axis segments thickened, falling with florets; lemma  $\pm$  round in x-section ..... **DESMAZERIA**
- 19' Spikelet axis segments not thickened, not falling with florets; lemma flattened
20. Lower glume broadly translucent distally and along margins; uppermost florets vestigial, densely clustered, sometimes appearing as a club-shaped rudiment; lf sheaths closed ..... <sup>2</sup>**MELICA**
- 20' Lower glume gen membranous or narrowly translucent near tip or margins only; uppermost florets, if vestigial, not densely clustered, club-shaped rudiment 0; lf sheaths open or closed
21. Lf sheath closed to near top; lemma tip 2-toothed; spikelets gen 15–70 mm ..... <sup>2</sup>**BROMUS**
- 21' Lf sheath open for at least 1/2 its length; lemma tip tapering to a point; spikelets gen 3.5–12(18) mm ..... <sup>2</sup>**FESTUCA**
- 14' Lemma awned
22. Infl often dense, cylindric, spike-like, or more open in full fl; spikelets shiny, palea colorless ..... <sup>2</sup>**KOELERIA**
- 22' Infl branching evident; spikelets not esp shiny; palea brown or green, at least along veins
23. Spikelets in dense, 1-sided clumps on distal portions of panicle branches; lemma keels stiff-ciliate ..... **DACTYLIS**
- 23' Spikelets not densely clumped at ends of panicle branches; lemma keels not stiff-ciliate
24. Lower glume broadly translucent distally and along margins; uppermost florets vestigial, densely clustered, sometimes appearing as a club-shaped rudiment; lf sheaths closed ..... <sup>2</sup>**MELICA**
- 24' Lower glume gen membranous or narrowly translucent near tip or margins only; uppermost florets, if vestigial, not densely clustered, club-shaped rudiment 0; lf sheaths open or closed
25. Spikelet axis hairy, extended beyond upper florets; upper glume  $\geq$  lowest floret ..... <sup>3</sup>**TRISETUM**
- 25' Spikelet axis gen glabrous, not extended beyond upper florets; upper glume < lowest floret
26. Lf sheath closed; spikelet gen 1+ cm; lemma tip 2-toothed; ovary tip hairy ..... <sup>2</sup>**BROMUS**
- 26' Lf sheath open for at least 1/2 its length (exc in *Festuca rubra*); spikelet gen < 1 cm; lemma tip entire; ovary tip glabrous ..... <sup>2</sup>**FESTUCA**

**AEGILOPS** GOAT GRASS

Ann. ST: gen erect to abruptly bent at base, gen glabrous. LF: sheath margins translucent, auricles ciliate; ligule membranous or 0; blade 1.5–15 cm, 1.5–5 mm wide, flat, spreading. INF: 1.5–11(15) cm, spike-like, cylindric or wider at base,  $\pm$  open