

## BORAGINACEAE

紫草科 zi cao ke

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Herbs perennial, biennial, or annual, less often lianas, shrubs, or trees, usually bristly or scabrous-pubescent. Leaves simple, exstipulate, alternate, rarely opposite, entire or serrate at margin. Inflorescences often double scorpioid cymes, rarely solitary; bracts present or absent. Flowers bisexual, actinomorphic, rarely zygomorphic. Calyx usually 5-parted or lobed, mostly persistent. Corolla tubular, campanulate, rotate, funnelform, or salverform; tube appendages 5, rarely more, mostly trapeziform, rarely absent, sometimes a ring of hairs present; limb usually 5-parted; lobes overlapping, rarely twisted in bud. Stamens 5, inserted on corolla tube or rarely at throat, included or rarely exerted; anthers introrse, 2-loculed, usually dorsifixed at base, less often medifixed, dehiscence longitudinal. Nectaries at base of corolla tube or on disc below ovary. Ovary superior, 2-carpellate; locules 2 and each with 2 ovules, or 4 and each with 1 ovule; ovules nearly atropous, semianatropous, or anatropous. Style terminal or gynobasic, branched or not. Gynobase flat, fastigiate, or subulate. Fruit 1–4-seeded drupes or nutlets (mericarps); nutlets mostly dry, often ornamented with wings, prickles and/or glochids (stiff bristles with barbed or anchorlike tips). Seeds vertical or oblique, coat membranous; embryo straight, less often curved; cotyledons flat, fleshy.

About 156 genera and 2500 species: temperate and tropical regions, centered in the Mediterranean region; 47 genera and 294 species in China, of which four genera and 156 species are endemic.

*Anchusa italica* Retzius, *A. officinalis* Linnaeus, and *Borago officinalis* Linnaeus are cultivated. *Borago officinalis* is uncommon and not naturalized, and because its seeds contain quality oil, it is probably more commonly grown than previously.

Wang Wen-tsai, Liu Yu-lan, Zhu Ge-ling, Lian Yong-shan, Wang Jing-quan & Wang Qing-rui in Kung Xian-wu & Wang Wen-tsai, eds. 1989. Boraginaceae. Fl. Reipubl. Popularis Sin. 64(2): 1–253.

- 1a. Ovary undivided; style terminal (at ovary apex).
- 2a. Style twice 2-cleft; stigmas 4; fruit drupes with 1 pyrene; cotyledons plicate ..... 1. *Cordia*
- 2b. Style 2-cleft or entire; stigmas 1 or 2; fruit drupes or nutletlike, usually divided into 2 or 4 pyrenes, rarely undivided; cotyledons not plicate.
- 3a. Style divided into a basal sterile terete portion that may be strongly reduced, and an upper conical portion; stigma 1, often forming a ring around style.
- 4a. Mature fruit with a fleshy or corky mesocarp ..... 7. *Tournefortia*
- 4b. Mature fruit dry, with thin mesocarp and bony endocarp ..... 6. *Heliotropium*
- 3b. Style usually 2-cleft, rarely entire; stigmas 2, capitate or elongated, rarely subpeltate, or 1, 2-cleft, lower part not inflated, without sterile portion.
- 5a. Fruit dry, without evident mesocarp, divided at maturity into 4 1-seeded mericarps; annual herbs ..... 5. *Coldenia*
- 5b. Fruit berrylike or drupe with evident fleshy mesocarp, undivided or divided at maturity into 2–4 mericarps; trees or shrubs.
- 6a. Style undivided; stigma somewhat 2-cleft, subpeltate, endocarp dividing into 4 1-seeded pyrenes ..... 3. *Rotula*
- 6b. Style 2-cleft; stigmas 2.
- 7a. Style 2-cleft to below middle; endocarp undivided, ovoid; leaf blade densely white spotted adaxially ..... 4. *Carmona*
- 7b. Style 2-cleft to above middle; endocarp divided into 2 2-seeded, rarely 4 1-seeded pyrenes; leaf blade not white spotted adaxially ..... 2. *Ehretia*
- 1b. Ovary (2- or) 4-lobed; style gynobasic (between ovary lobes).
- 8a. Ovary 2-lobed; ovules 2, potentially maturing into 2 nutlets ..... 39. *Rochelia*
- 8b. Ovary 4-lobed; ovules 4, potentially maturing into 4 nutlets.
- 9a. Connective of anthers prominently subulate, spirally twisted ..... 36. *Trichodesma*
- 9b. Connective of anthers not subulate, not spirally twisted.
- 10a. Corolla throat unappendaged.
- 11a. Anthers coherent at least at base, sagittate; corolla lobes toothed.
- 12a. Calyx parted to middle or slightly below, lobes triangular; corolla with inflated ribs below lobes and deep furrows between them ..... 11. *Maharanga*

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- 12b. Calyx parted to base, lobes linear or linear-lanceolate; corolla without ribs or deep furrows ..... 12. *Onosma*
- 11b. Anthers free, not sagittate at base; corolla lobes mostly not toothed.
- 13a. Stamens exserted; nutlet with a cupular emergence abaxially, attachment scar below middle adaxially; gynobase narrowly fastigiata ..... 35. *Craniospermum*
- 13b. Stamens included; nutlet without a cupular emergence, attachment scar basal; gynobase flat.
- 14a. Corolla zygomorphic, lobes unequal ..... 13. *Echium*
- 14b. Corolla actinomorphic, lobes subequal.
- 15a. Style undivided; nutlet smooth, attachment scar with umbilical tissue ..... 14. *Pulmonaria*
- 15b. Style 2- or 4-divided; nutlet tuberculate, attachment scar without umbilical tissue.
- 16a. Nutlet with short stipe at base; stamens spirally arranged; style shortly 2-cleft ..... 10. *Stenosolenium*
- 16b. Nutlet without stipe; stamens in single whorl, if spirally arranged (*Arnebia decumbens*) then flowers yellow; style twice 2-cleft ..... 9. *Arnebia*
- 10b. Corolla throat or tube with prominent appendages, longitudinal folds, or hair bands.
- 17a. Calyx lobes unequal, strongly enlarged in fruit, bilaterally compressed, becoming somewhat clamshell-shaped ..... 38. *Asperugo*
- 17b. Calyx lobes subequal, slightly enlarged in fruit, not clamshell-shaped.
- 18a. Attachment scar concave, with umbilical tissue, margin with ringlike emergence.
- 19a. Corolla appendages below throat ..... 16. *Nonea*
- 19b. Corolla appendages at throat.
- 20a. Stamens and corolla appendages at same level; corolla lobes dentate ..... 18. *Symphytum*
- 20b. Stamens below corolla appendages; corolla lobes not dentate.
- 21a. Corolla appendages short pubescent; plants sparsely strigose or hispid ..... 15. *Anchusa*
- 21b. Corolla appendages pilose; plants short strigose, bristly ..... 17. *Gastrocotyle*
- 18b. Attachment scar not concave, without umbilical tissue or ringlike emergence.
- 22a. Anthers mucronulate at apex; nutlets ovoid, smooth, white or gray ..... 8. *Lithospermum*
- 22b. Anthers not mucronulate at apex; nutlets not ovoid, often not smooth and/or not white or gray.
- 23a. Nutlets with glochids or wings.
- 24a. Gynobase flat; stem leaves subglabrous.
- 25a. Abaxial surface of nutlet with cupular or crownlike emergence formed by confluent bases of glochids ..... 31. *Actinocarya*
- 25b. Abaxial surface of nutlet without emergence; glochids on adaxial surface coherent into wings ..... 32. *Metaeritrichium*
- 24b. Gynobase fastigiata or subulate; stem leaves bristly, rarely glabrous.
- 26a. Corolla limb shorter than tube; stamens and style exserted.
- 27a. Stamens inserted above appendages; anthers much shorter than filaments, base not hastate ..... 45. *Solananthus*
- 27b. Stamens inserted below appendages; anthers ca. as long as to longer than filaments, base hastate.
- 28a. Nutlets globose or ovoid, ca. 15 mm, without prickles, broadly winged ..... 44. *Rindera*
- 28b. Nutlets compressed, ovate, ca. 6 mm, margins without wings, with dense glochids ..... 43. *Lindelofia*
- 26b. Corolla limb ca. as long as to longer than tube; stamens and style included.
- 29a. Attachment scar at apex of nutlet.
- 30a. Abaxial cupular emergence of nutlet broadly winged ..... 47. *Mattiastrum*
- 30b. Abaxial cupular emergence of nutlet not winged ..... 42. *Cynoglossum*
- 29b. Attachment scar at or below middle on adaxial surface of nutlets.

- 31a. Gynobase pyramidal, much shorter than nutlets or nearly flat.
- 32a. Gynobase short pyramidal, to 2–3 mm; fruiting pedicel always deflexed ..... 29. *Hackelia*
- 32b. Gynobase nearly flat, to 1 mm; fruiting pedicel erect or deflexed ..... 28. *Eritrichium*
- 31b. Gynobase subulate, ca. as long as to longer than nutlets.
- 33a. Adaxial surface of nutlet joined to gynobase (not easily stripped) ..... 34. *Heterocaryum*
- 33b. Adaxial surface of nutlet free from gynobase (easily stripped) ..... 33. *Lappula*
- 23b. Nutlets without glochids or wings.
- 34a. Nutlets tetrahedral or lenticular.
- 35a. Nutlet with adaxial membranous cupular emergence.
- 36a. Leaf blade ovate-cordate; fruiting calyx extremely enlarged, enclosing fruit ..... 21. *Sinojohnstonia*
- 36b. Leaf blade elliptic-ovate; fruiting calyx slightly enlarged, not enclosing fruit ..... 22. *Omphalotrigonotis*
- 35b. Nutlet without membranous cupular emergence.
- 37a. Stamens included.
- 38a. Corolla lobes convolute; nutlets lenticular ..... 19. *Myosotis*
- 38b. Corolla lobes overlapping; nutlets tetrahedral or 3-angled ..... 20. *Trigonotis*
- 37b. Stamens exerted.
- 39a. Leaves nearly whorled at apex of stem ..... 23. *Brachybotrys*
- 39b. Leaves alternate along stem ..... 24. *Mertensia*
- 34b. Nutlets neither tetrahedral nor lenticular.
- 40a. Stamens exerted ..... 41. *Antiotrema*
- 40b. Stamens included.
- 41a. Flowers solitary, terminal; perennial alpine cushion plant ..... 27. *Chionocharis*
- 41b. Flowers several to numerous, in cymes.
- 42a. Nutlet without an emergence on either surface.
- 43a. Gynobase nearly flat; nutlets glabrous, shiny ..... 25. *Amblynotus*
- 43b. Gynobase subulate or terete.
- 44a. Nutlets short hispid, abaxial surface completely coherent to gynobase ..... 37. *Lasiocaryum*
- 44b. Nutlets glabrous, abaxial surface free except for basal attachment scar which is coherent to gynobase ..... 26. *Microcaryum*
- 42b. Nutlets with a discoid or cupular emergence on abaxial or adaxial surface.
- 45a. Cupular emergence with 2 layers, margin of outer layer dentate ..... 46. *Thyrocarpus*
- 45b. Cupular emergence with 1 layer, if 2, margin of outer layer entire.
- 46a. Nutlet with cupular emergence adaxially ..... 40. *Bothriospermum*
- 46b. Nutlets with cupular emergence on abaxial surface, surrounding an aperture ..... 30. *Microula*

## 1. *CORDIA* Linnaeus, Sp. Pl. 1: 190. 1753.

破布木属 po bu mu shu

Trees or shrubs. Leaves alternate, rarely opposite, usually evidently petiolate, margin entire or serrate, rarely lobed. Cymes mostly corymbose, ebracteate. Flowers bisexual, frequently heterostylous or  $\pm$  functionally unisexual. Calyx tubular or campanulate, enlarged after anthesis, persistent. Corolla white, yellow, or orange-red, campanulate to funnellform, usually (4- or) 5(–8)-lobed; lobes antrorse or recurved. Stamens usually well developed; filaments often pubescent at base. Ovary 4-loculed,

glabrous; ovule 1 per locule. Style twice 2-cleft, each branch with a spatulate or capitate stigma. Drupes ovoid, globose, or ellipsoid, frequently with watery or sticky fleshy mesocarp and bony endocarp, rarely with corky mesocarp or nutlike without fleshy mesocarp. Seeds 1–4, without endosperm; cotyledons plicate.

About 325 species: mostly in tropics of North and South America, poorly represented in Africa and Asia; five species in China.

- 1a. Corolla orange, more than 3 cm; mesocarp corky, fruit enclosed by accrescent tubular calyx ..... 1. *C. subcordata*
- 1b. Corolla white or pale yellow, less than 2 cm; mesocarp mucilaginous to watery, sticky, fleshy, fruit subtended but not enclosed by persistent cupular calyx.
  - 2a. Calyx with prominent longitudinal veins ..... 2. *C. kanehirai*
  - 2b. Calyx without longitudinal veins.
    - 3a. Leaf blade densely pubescent abaxially; cymes terminal, extra-axillary ..... 3. *C. furcans*
    - 3b. Leaf blade glabrous abaxially or only veins and vein axils pubescent; inflorescences at apices of leafy lateral branches.
      - 4a. Leaf blade oblong to ovate; calyx lobes irregularly angular; inflorescences crowded in glomerules ..... 4. *C. cochinchinensis*
      - 4b. Leaf blade ovate to elliptic; margin of calyx somewhat undulate; inflorescences widely spaced, in flat-topped cymes ..... 5. *C. dichotoma*

**1. *Cordia subcordata*** Lamarck, Tabl. Encycl. 1: 421. 1792.

橙花破布木 cheng hua po bu mu

Trees to ca. 3 m tall; bark yellow-brown; branchlets glabrous. Petiole 3–6 cm, glabrous; leaf blade ovate to narrowly ovate, 8–18 × 6–13 cm, abaxially densely cottony in vein axils, adaxially ± spotted, base obtuse to rounded, rarely cordate, margin entire to subundulate, apex acuminate to acute. Cymes opposite leaves, ca. 12 cm wide at anthesis. Pedicel 3–6 mm. Calyx cylindrical, ca. 13 × 8 mm, leathery; lobes irregular, short. Corolla orange, funnellform, 3.4–4.5 cm; throat ca. 4 cm wide; lobes divaricate, orbicular. Drupes ovoid or obovoid, ca. 2.5 cm, with corky mesocarp, enclosed by enlarged persistent calyx. Fl. Jun.

Sandy, open woodland. Hainan (Yaxian Xian), Nanhai Zhudao [India, Indonesia, Thailand, Vietnam; Africa (E coast), Pacific Islands].

**2. *Cordia kanehirai*** Hayata, Icon Pl. Formosan. 6: 31. 1916.

台湾破布木 tai wan po bu mu

Trees small, dichotomously branched; branchlets light brown, terete, pubescent when young, glabrous in age. Petiole 1.5–3 cm; leaf blade lanceolate, 8–14 × 2.5–5 cm, densely appressed pubescent when young, glabrous in age, base cuneate to rounded, margin entire or inconspicuously serrate, apex acuminate to mucronate. Cymes terminal and lateral, widely spaced, 3–6 cm wide. Calyx cylindrical, 4–5 mm, densely strigose, margin with 5 small teeth, with 10 longitudinal veins. Corolla white; lobes tuberculate adaxially, ca. as long as tube. Stamens inserted above middle of corolla tube, slightly exserted. Drupes ellipsoid, straight, ca. 12 × 8 mm, subtended by persistent calyx; endocarp forming an elongated pyrene, irregularly wrinkled, tuberculate.

Taiwan [Japan].

*Cordia kanehirai* has been misidentified as *C. cumingiana* Vidal (of the Philippines), but it differs from that by having much narrower leaves.

**3. *Cordia furcans*** I. M. Johnston, J. Arnold Arbor. 32: 5.

1951.

二叉破布木 er cha po bu mu

Trees 5–15 m tall; bark gray. Petiole 3–6 cm; leaf blade ovate to elliptic, 5–15 × 4–12 cm, abaxially densely pubescent, rarely subglabrous, adaxially hispid, base rounded, rarely broadly cuneate or cordate, margin usually entire, rarely with inconspicuous obtuse teeth, apex obtuse. Cymes terminal and lateral; lateral cymes extra-axillary, 8–12 cm wide. Flowers sessile or nearly so, dimorphic, 4- or 5-merous. Calyx campanulate, ca. 5 mm, irregularly lobed; lobes 1–1.5 mm. Corolla white, 6.5–8.5 mm; tube 2.5–3 mm; throat with long white hairs; lobes oblong, 4–5.5 mm, recurved. Filaments ca. 3.5 mm in staminate flowers, 0.5–1 mm in bisexual flowers. Ovary ovoid. Style undeveloped, ca. 4 mm, first branches 1.5–2 mm, second branches 3–2.5 mm; stigma spatulate. Drupes red or pale red, ellipsoid, 5–8 mm in diam., glabrous or sparsely pubescent, surrounded by a lobed cupular persistent calyx. Fl. Nov, fr. Jun.

Open woodlands, roadsides; 100–1200 m. Guangxi, Hainan, Yunnan [India, Myanmar, Thailand, Vietnam].

**4. *Cordia cochinchinensis*** Gagnepain in Lecomte, Fl. Indo-Chine 4: 203. 1914.

越南破布木 yue nan po bu mu

Trees or climbing shrubs, 2–4 m tall. Petiole 1–2 cm; leaf blade oblong to ovate, 3–8 × 2–3.5 cm, adaxially sometimes densely spotted, base cuneate to rounded, rarely cordate, margin entire, apex obtuse to retuse; vein axils with tufts of short hairs. Inflorescences terminating lateral branches, in glomerules. Flowers bisexual, externally glabrous. Calyx cupular, 7–8 mm; lobes 4 or 5, irregular, angular. Corolla white or pale yellow, glabrous, 1.4–1.6 cm; tube ca. as long as lobes. Filaments 3.5–4.5 mm, glabrous or sparsely short pubescent, anthers ca. 1.5 mm. Style ca. 3 mm, first branches ca. 1 mm, second branches 3.5–5 mm. Drupes subglobose, 8–10 mm in diam., surrounded by persistent calyx. Fr. Aug-Dec.

Woods along beaches, arid sandy hills. Hainan (Yaxian Xian) [Thailand, Vietnam].

As noted by Johnston (J. Arnold Arbor. 32: 11. 1951), the description does not agree with that of the type of *Cordia cochinchinensis*. The true identity of the Chinese specimens is not clear at present.

**5. *Cordia dichotoma*** G. Forster, Fl. Ins. Austr. 18. 1786.

破布木 po bu mu

*Varronia sinensis* Loureiro.

Trees 3–4(–20) m tall. Petiole 2–5 cm; leaf blade ovate to broadly ovate or elliptic, 6–13 × 4–9 cm, sparsely pubescent or glabrous, base rounded to broadly cuneate, margin usually subundulate to undulate dentate, rarely entire, apex obtuse to mucronate. Inflorescences terminating leafy lateral branches, dichotomously branched into corymbose cymes, widely spaced, 5–8 cm wide. Flowers dimorphic,

sessile. Calyx campanulate, 5–6 mm, 5-lobed; lobes unequal, triangular. Corolla white, ca. as long as calyx; lobes shorter than tube, margin somewhat undulate. Filaments of staminate flowers ca. 3.5 mm, filaments of bisexual flowers 1–2 mm. Rudimentary pistil globose. Style united portion 1–1.5 mm, first branches ca. 1 mm, second branches 2–3 mm; stigma spatulate. Drupes yellow or reddish, subglobose, 1–1.5 cm in diam., with sticky mesocarp, surrounded by persistent calyx. Fl. Feb–Apr, fr. Jun–Aug.  $2n = 48, 50$ .

Open woods on slopes, mountain streamsides. Fujian, Guangdong, Guangxi, Guizhou, Taiwan, SE Xizang, Yunnan [Cambodia, N India, Indonesia, Japan (Ryukyu Islands), Kashmir, Laos, Malaysia, Myanmar, Pakistan, Thailand, Vietnam; NE Australia, Pacific Islands].

The seeds contain oil, the fruit is used for medicine, and the wood is used for house construction and farm tools.

**2. EHRETIA** P. Browne, Civ. Nat. Hist. Jamaica 168. 1756.

厚壳树属 hou ke shu shu

Trees or shrubs. Leaves petiolate, entire or serrate at margin. Inflorescences corymbose or paniculate-cymose. Calyx 5-lobed. Corolla white or pale yellow, tubular or tubular-campanulate, rarely funnellform, 5-lobed; lobes spreading or reflexed. Filaments usually exerted; anthers ovate to oblong or linear. Ovary ovoid, 2-loculed, each locule with 2 ovules. Style terminal, 2-cleft; stigmas 2, capitate or elongated. Drupes yellow, orange, or pale red, subglobose, glabrous, endocarp divided at maturity into 2 2-seeded or 4 1-seeded pyrenes.

About 50 species: mostly in Africa and S Asia, three in North America and the Caribbean; 14 species in China, mainly S of the Chang Jiang.

- 1a. Leaves serrate; endocarp divided at maturity into 2 2-seeded pyrenes.
  - 2a. Leaves glabrous, teeth antrorse, apiculate; corolla lobes longer than tube; drupes 3–4 mm in diam. .... 1. *E. acuminata*
  - 2b. Leaves pubescent abaxially, teeth spreading, not apiculate; corolla lobes shorter than tube; drupes 6–15 mm in diam.
    - 3a. Leaf base cuneate to rotund, blade pubescent adaxially; drupes 10–15 mm in diam. .... 3. *E. dicksonii*
    - 3b. Leaf base cordate, blade densely tomentose adaxially; drupes 3–4 mm in diam. .... 2. *E. corylifolia*
- 1b. Leaves entire; endocarp divided at maturity into 4 1-seeded pyrenes.
  - 4a. Corolla lobes longer than tube.
    - 5a. Inflorescences and calyx densely yellow-brown pubescent, ebracteate ..... 14. *E. laevis*
    - 5b. Inflorescences glabrous or nearly so, with linear or linear-lanceolate bracts.
      - 6a. Petiole tuberculate; leaf blade broadly elliptic to oblong-elliptic, apex obtuse or mucronate; flowers pedicellate ..... 12. *E. asperula*
      - 6b. Petiole smooth; leaf blade lanceolate to oblong-lanceolate, apex acute; flowers sessile ..... 13. *E. hainanensis*
  - 4b. Corolla lobes shorter than tube.
    - 7a. Corolla tube cylindrical; calyx lobes linear, 5–6 mm.
      - 8a. Calyx 4–6 mm; stamens inserted at apex of corolla tube ..... 4. *E. resinosa*
      - 8b. Calyx ca. 3 mm; stamens inserted at middle of corolla tube ..... 5. *E. densiflora*
    - 7b. Corolla tube distinctly wider distally; calyx lobes ovate to oblong, 1.5–3.5 mm.
      - 9a. Cymes terminal; corolla funnellform, 5.5–6.5 mm; filaments ca. 1.5 mm ..... 6. *E. confinis*
      - 9b. Cymes terminal and lateral; corolla tube campanulate, 7–11 mm; filaments ca. 3–6 mm.
        - 10a. Leaf blade with evident reticulate venation.
          - 11a. Inflorescences and calyx obscurely pubescent with glandular hairs ..... 7. *E. tsangii*
          - 11b. Inflorescences and calyx with rust-colored glandular hairs ..... 8. *E. dunniana*
        - 10b. Leaf blade with only midvein and lateral veins conspicuous.
          - 12a. Petiole, calyx, and corolla densely rust-colored pubescent ..... 9. *E. pingbianensis*
          - 12b. Petiole and corolla glabrous, calyx ciliate.
            - 13a. Corolla 10–11 mm, lobes ovate; filaments 8–10 mm, inserted 3.5–5 mm above base ..... 10. *E. longiflora*

- 13b. Corolla 6.5–8 mm, lobes oblong-lanceolate; filaments 2.5–3 mm, inserted just below throat ..... 11. *E. changjiangensis*

**1. *Ehretia acuminata*** R. Brown, Prodr. 147. 1810.

厚壳树 hou ke shu

*Cordia thyrsoflora* Siebold & Zuccarini; *Ehretia acuminata* var. *grandifolia* Pampanini; *E. acuminata* var. *obovata* (Lindley) I. M. Johnston; *E. argyi* H. Léveillé; *E. kantonensis* Masamune; *E. serrata* Roxburgh var. *obovata* Lindley; *E. taiwaniana* Nakai; *E. thyrsoflora* (Siebold & Zuccarini) Nakai.

Trees to 15 m tall; bark black-gray, lacinate; branches light brown, smooth; branchlets brown, glabrous, with distinct lenticels; axillary buds solitary, compressed. Petiole 1.5–2.5 cm, glabrous; leaf blade elliptic to obovate or oblong-obovate, 5–13 × 4–6 cm, glabrous or sparsely puberulent, base broadly cuneate, margin regularly serrate with teeth curved upward, apex acute, apiculate. Cymes paniculate, 8–15 × 5–8 cm, short pubescent or subglabrous. Flowers crowded, fragrant. Calyx 1.5–2 mm; lobes ovate, ciliate. Corolla white, campanulate, 3–4 mm; lobes spreading, oblong, longer than tube. Stamens exserted; filaments 2–3 mm, inserted on upper part of base, 0.5–1 mm; anthers ovate, ca. 1 mm. Style 1.4–2.5 mm, branches ca. 0.5 mm. Drupes yellow or orange, 3–4 mm in diam.; endocarp wrinkled, divided at maturity into 2 2-seeded pyrenes.  $2n = 30, 32, 36$ .

Hills, open forests, thickets on slopes; 100–1700 m. Guangdong, Guangxi, Guizhou, Henan, Hunan, Jiangsu, Jiangxi, Shandong, Sichuan, Taiwan, Yunnan, Zhejiang [Bhutan, India, Indonesia, Japan, Vietnam; Australia].

*Ehretia acuminata* is a widespread species with much variation. Chinese and Japanese plants named as *E. thyrsoflora* are not specifically different from the Australian type, and the varieties recognized by Johnston (J. Arnold Arbor. 32: 21. 1951) show no geographical correlations. Attempts to subdivide the complex have not been successful, and it seems most appropriate to apply the specific epithet in a very wide sense.

Used for roadside plantings and the timber for building and furniture. The leaves and branchlets are used in Chinese medicine.

**2. *Ehretia corylifolia*** C. H. Wright, Bull. Misc. Inform. Kew 1896: 25. 1896.

西南厚壳树 xi nan hou ke shu

Trees ca. 12 m tall; bark black-gray; branches gray-brown, glabrous; branchlets and inflorescences densely pubescent. Leaf blade ovate or elliptic, 6–14 × 4–8 cm, abaxially soft puberulent or sparsely short pubescent, adaxially densely tomentose, base usually cordate, margin obtuse-serrate, apex acute. Cymes terminating branchlets, paniculate. Pedicel short or lacking. Calyx 2–3 mm, parted nearly to base; lobes oblong to lanceolate, pubescent. Corolla white, tubular-campanulate, fragrant, 6–9 mm; lobes oblong to rounded, 2.5–3.5 mm, shorter than tube, pubescent outside. Filaments ca. 2 mm; anthers oblong, 1.5–2 mm. Style 6–7.5 mm, pubescent, branches ca. 0.5 mm. Drupes red, yellow, or orange, 3–4 mm in diam.; endocarp ellipsoid to subglobose, ca. 7 mm, divided at maturity into 2 2-seeded pyrenes. Fl. May, fr. Jun-Jul.

- 1500–3000 m. NW, S and SW Yunnan.

**3. *Ehretia dicksonii*** Hance, Ann. Sci. Nat. Bot., ser. 4, 18: 224. 1862.

粗糠树 cu kang shu

*Ehretia dicksonii* var. *tomentosa* Nakai; *E. macrophylla* Wallich var. *tomentosa* Gagnepain & Courchet.

Trees ca. 15 m tall; bark gray-brown, fissured; branches brown; branchlets light brown, pubescent. Petiole 1–4 cm, pubescent; leaf blade broadly elliptic, elliptic, ovate, or obovate, 8–25 × 4–15 cm, abaxially densely and minutely hispid, hairs discoid at base, extremely scabrous, adaxially densely pubescent, base cuneate or rotund, margin serrate, apex acute. Cymes terminal, corymbose or paniculate, 6–9 cm wide, bracteate or not; bracts linear, ca. 5 mm. Flowers sessile or nearly so. Calyx 3.5–4.5 mm, parted nearly to base; lobes oblong or ovate, pubescent. Corolla white to pale yellow, tubular-campanulate, fragrant, 8–10 mm, base ca. 2 mm wide; throat 6–7 mm wide; lobes oblong, 3–4 mm, shorter than tube. Stamens exserted from corolla; filaments 3–4.5 mm; anthers 1.5–2 mm. Style 6–9 mm, glabrous, rarely appressed pubescent, branches 1–1.5 mm. Drupes yellow, subglobose, 1–1.5 cm in diam.; endocarp divided at maturity into 2 2-seeded pyrenes. Fl. Mar-May, fr. Jun-Jul.  $2n = 40^*$ .

Open forests on slopes, shaded moist hillsides; 100–2300 m. Fujian, S Gansu, Guangdong, Guangxi, Guizhou, Hainan, Henan, Hunan, Jiangsu, Jiangxi, S Qinghai, Shaanxi, Sichuan, Taiwan, Yunnan, Zhejiang [Bhutan, Japan, Nepal, Vietnam].

Planted as an ornamental tree.

Plants with abaxially glabrous, shiny leaves have been recognized as *Ehretia macrophylla* Wallich var. *glabrescens* (Nakai) Y. L. Liu (Bull. Bot. Lab. N.E. Forest. Inst., Harbin 9: 71. 1980) [*E. dicksonii* Hance var. *glabrescens* Nakai (J. Arnold Arbor. 5: 40. 1924) or *E. dicksonii* var. *tilioides* I. M. Johnston (J. Arnold Arbor. 32: 101. 1951)] and occur in thickets and forests at 100–1700 m in Guangxi, Guizhou, Hubei, Sichuan, and Xizang.

**4. *Ehretia resinosa*** Hance, J. Bot. 18: 299. 1880.

台湾厚壳树 tai wan hou ke shu

*Ehretia formosana* Hemsley; *E. navesii* Vidal.

Shrubs or trees. Petiole 1–2 cm; leaf blade broadly ovate to rounded, 6–16 × 4–10 cm, abaxially pubescent, adaxially tomentose, base rounded, margin entire or dentate, apex acute. Cymes terminal, densely pubescent; peduncle 1–3 cm. Calyx 4–6 mm. Corolla tubular, ca. 3 mm. Stamens inserted at apex of corolla tube. Drupes globose, 5–7 mm in diam., usually 4-seeded. Fl. Apr.

Nanhai Zhudao, Taiwan [Philippines].

**5. *Ehretia densiflora*** F. N. Wei & H. Q. Wen, Guihaia 11: 216. 1991.

密花厚壳树 mi hua hou ke shu

Branches with reddish pubescent juvenile branchlets. Leaf blade elliptic, 5–11 × 2.5–5 cm, thick, papery; brown and puberulent when young, glabrous when mature, grayish green when dry; base acute, cuneate; veins 4, arcuate. Petiole 5–10 mm. Cymes terminal, thyrsoïd, only 2–3 cm, densely brown woolly and white pubescent, many flowered; bracts 4–5 mm. Flowers ± sessile. Calyx ca. 3 mm; lobes lanceolate, brownish woolly. Corolla white, cylindrical, 5-lobed; lobes rounded. Stamens inserted at middle of corolla tube. Ovary globose. Style single; stigma 2-lobed. Drupes ca. 3 mm in diam., divided at maturity into 4 1-seeded pyrenes. Fl. Jun–Jul.

- Guangxi.

6. *Ehretia confinis* I. M. Johnston, J. Arnold Arbor. 32: 103. 1951.

云南厚壳树 yun nan hou ke shu

Trees 5–10 m tall; branches pale, gray-brown, glabrous; branchlets brown, with linear or oblong lenticels, glabrous. Petiole 1–2 cm, glabrous; leaf blade oblong to elliptic or obovate, 5–8 × 2–4 cm, glabrous, base attenuate to rounded, margin entire or somewhat undulate, apex acute. Cymes terminal, dense, subglobose, ca. 4 cm wide. Corolla funnelliform, 5.5–6.5 mm. Filaments 5–6 mm, inserted ca. 1.5 mm above base of corolla tube; anthers ca. 1.2 mm. Drupes 5–7 mm in diam.; endocarp wrinkled, divided at maturity into 4 1-seeded pyrenes.

- Forests; 700–2400 m. SW Yunnan.

7. *Ehretia tsangii* I. M. Johnston, J. Arnold Arbor. 32: 104. 1951.

上思厚壳树 shang si hou ke shu

Trees 3–5 m tall; branches gray-brown; branchlets brown, glabrous, with linear or oblong lenticels. Leaf blade elliptic to oblong-elliptic, 5–12 × 3–6.5 cm, glabrous, abaxially pubescent only in vein axils, base cuneate, margin entire, apex abruptly acute; lateral veins 5 or 6 pairs, reticulate veins obvious. Cymes terminal and lateral, flat topped, 3–8 cm wide, obscurely pubescent. Calyx 1.5–2.5 mm, obscurely glandular pubescent; lobes ovate, 1–1.5 mm, ciliolate. Corolla white, tubular-campanulate, fragrant, 7–8.5 mm, base 1.5–2 mm wide, gradually expanded upward; throat 3–4.5 mm wide; lobes oblong, 3–4 mm, shorter than tube, margin revolute. Filaments 2.5–3.5 mm, inserted at upper part of base, 3–4 mm; anthers 1.5–2 mm. Style 5–6 mm, glabrous, branches ca. 1 mm. Drupes yellow, ca. 5 mm in diam.; endocarp divided at maturity into 4 1-seeded pyrenes. Fl. Mar, fr. Apr.

- Valley forests; 200–500 m. S and W Guangxi, S Guizhou, SE Yunnan.

8. *Ehretia dunniana* H. Léveillé, Repert. Spec. Nov. Regni Veg. 11: 65. 1912.

云贵厚壳树 yun gui hou ke shu

*Ehretia volubilis* Handel-Mazzetti.

Trees 10–15 m tall; branchlets dark brown, glabrous; young branches with thin glandular hairs. Petiole 2–3 cm, glabrous; leaf blade elliptic to oblong, 10–18 × 5–10 cm, glabrous, base broadly cuneate to rounded, apex abruptly acute; lateral veins 6–8 pairs, reticulate veins obvious. Cymes terminating lateral branches, flat topped, 6–7 cm wide, densely pubescent, glandular. Calyx 3–3.5 mm, densely thin glandular pubescent; lobes oblong, 1.2–2 mm, ciliolate. Corolla white, tubular-campanulate, 1–1.1 cm, fragrant, base 1–1.5 mm wide, gradually expanded upward; throat 4–4.5 mm wide; lobes oblong, 4–5 mm, obviously shorter than tube. Filaments 2.5–3 mm, inserted at upper part of base, 5.5–6 mm; anthers 1.5–2 mm. Style 8–8.5 mm, glabrous, branches 0.5–1 mm. Drupes red to dark red at maturity, ca. 1 cm in diam.; endocarp divided at maturity into 4 1-seeded pyrenes. Fl. Mar, fr. Apr.

- Open forests on slopes; ca. 1600 m. Guizhou, SE Yunnan.

*Ehretia dunniana* is very similar to *E. longiflora* Champion ex Bentham, and differs by having conspicuous reticulate veins and densely rust-colored glandular inflorescences, calyces, and young branches. Léveillé (Repert. Spec. Nov. Regni Veg. 11: 65. 1912), described the cymes as “villous,” but Johnston (J. Arnold Arbor. 32: 104. 1951) indicated that they are densely covered with reddish brown, short, stipitate glands, as described here. Glands are also found in the type of *E. volubilis* Handel-Mazzetti.

9. *Ehretia pingbianensis* Y. L. Liu, Acta Phytotax. Sin. 22: 319. 1984.

屏边厚壳树 ping bian hou ke shu

Trees ca. 10 m tall; bark light brown to gray-brown, ± smooth; branchlets dark brown, glabrous. Petiole 1–2.5 cm, densely rust-colored pubescent; leaf blade elliptic to ovate or ovate-lanceolate, 7–10 × 4–6 cm, densely rust-colored pubescent, sometimes subglabrous, if glabrous then margin and veins pubescent, base broadly cuneate to rounded, apex obtuse to somewhat acute; lateral veins 6–8 pairs, reticulate veins inconspicuous. Cymes terminating lateral branches, crowded, flat topped, 3–6 cm wide at anthesis, densely rust-colored pubescent. Flowers sessile. Calyx campanulate, 2.5–3.5 mm, shorter than corolla tube, parted to middle or slightly below, densely rust-colored pubescent outside; lobes lanceolate or triangular-lanceolate, rarely oblong. Corolla white, tubular-campanulate, 1–1.1 cm, base ca. 1.5 mm wide; limb 4–5 mm wide; lobes oblong, 2–3.5 mm, recurved, densely rust-colored pubescent outside, margin revolute. Stamens exerted; filaments 6–7 mm, inserted at middle of corolla tube or slightly below; anthers oblong, 1–1.5 mm. Style 0.9–1.1 cm, exerted. Drupes unknown. Fl. Mar.

- Slopes, meadows, margins of cultivated ground; 800–1800 m. SW Yunnan.

10. *Ehretia longiflora* Champion ex Bentham, Hooker's J. Bot. Kew Gard. Misc. 5: 58. 1853.

长花厚壳树 chang hua hou ke shu

*Ehretia glaucescens* Hayata.

Trees 5–10 m tall; bark dark gray to dark brown, scaly; branches brown; branchlets purple-brown, glabrous. Petiole 1–2 cm, glabrous; leaf blade elliptic to oblong or oblong-ob lanceolate, 3–12 × 2–6 cm, glabrous, base cuneate, rarely rounded, margin entire, apex acute; lateral veins 4–7 pairs, reticulate veins inconspicuous. Cymes terminating lateral branches, flat topped, 3–6 cm wide, glabrous or sparsely pubescent. Flowers sessile or on short pedicels. Calyx 1.5–2 mm, glabrous; lobes ovate, inconspicuously ciliate. Corolla white, tubular-campanulate, 1–1.1 cm, base ca. 1.5 mm wide, glabrous; throat 4–5 mm wide; lobes spreading or slightly recurved, ovate to elliptic-ovate, 2–3 mm, shorter than tube. Filaments 8–10 mm, inserted 3.5–5 mm above base; anthers ca. 1 mm. Style 7–8 mm, branches ca. 1 mm. Drupes pale yellow or red, 0.8–1.5 cm in diam.; endocarp ribbed, divided at maturity into 4 1-seeded pyrenes. Fl. Apr.

Open forests, slopes, moist valleys; 300–900 m. Fujian, Guangdong, Guangxi, Taiwan [Vietnam].

**11. *Ehretia changjiangensis*** Xing & Z. X. Li, Acta Phytotax. Sin. 31: 472. 1993.

昌江厚壳树 chang jiang hou ke shu

Shrubs climbing, to 3–6 m tall. Branches gray-brown, stout, glabrous. Petiole 2–9 mm, smooth; leaf blade oblong-elliptic or ovate, 1.5–5 × 0.5–2 cm, leathery, sparsely pubescent when young, later glabrescent, base cuneate, apex rounded. Cymes terminal, flat topped, 2–5 cm wide, densely pubescent, many flowered; peduncle 2–4 cm; bracts linear, 3–4 mm, caducous. Pedicel 1–1.5 mm. Calyx ca. 2.5 mm, deeply lobed; lobes ca. 0.8 mm wide, sparsely pubescent, apex acute or rounded. Corolla white, tubular-campanulate, 6.5–8 mm, glabrous; tube ca. 5 mm, ca. 1.5 mm wide at base, 3–4 mm wide at throat; lobes oblong, 2–3 mm, apex rounded. Filaments 2.5–3 mm, inserted at throat, exerted; anthers oblong, ca. 1.2 mm, dorsifixed. Style ca. 7 mm; lobes ca. 1 mm, exerted. Drupes subglobose, 3–4 mm in diam. Seeds 4, conspicuously rugose.

• On limestone; ca. 300 m. Hainan.

Most closely related to *Ehretia asperula*, but distinguished by the smaller leaves with fewer lateral veins, smooth petioles, corolla lobes shorter than the tube, and long style.

**12. *Ehretia asperula*** Zollinger & Moritzi in Moritzi, Syst. Verz. 52. 1846.

宿苞厚壳树 su bao hou ke shu

Shrubs climbing, 3–5 m tall; branches gray-brown, stout, glabrous; branchlets brown or light brown, pubescent when young. Petiole 0.6–1.5 cm, tuberculate; leaf blade broadly elliptic to oblong-elliptic, 3–12 × 2–6 cm, leathery, glabrous or abaxially pubescent in vein axils, base rounded, margin usually entire, apex obtuse or mucronate. Cymes light brown,

terminating branchlets, flat topped, 4–6 cm wide, pubescent; bracts linear to linear-ob lanceolate, 3–10 mm, sometimes curved, persistent. Pedicel 1.5–3 mm. Calyx brown, 1.5–2.5 mm, pubescent. Corolla white, funnellform, 3.5–4 mm, base ca. 1.5 mm wide; throat ca. 5 mm wide; lobes triangular-ovate, 2–2.5 mm, slightly longer than tube. Filaments 3.5–4 mm, inserted at upper part of base, ca. 1 mm; anthers ca. 1 mm. Style 3–4 mm, branches ca. 1 mm. Drupes red or orange, 3–4 mm in diam.; endocarp divided at maturity into 4 1-seeded pyrenes.

Arid slopes, open forests. Hainan [Indonesia, Vietnam].

**13. *Ehretia hainanensis*** I. M. Johnston, J. Arnold Arbor. 32: 108. 1951.

海南厚壳树 hai nan hou ke shu

Trees ca. 8 m tall; bark gray; branchlets light gray, glabrous. Petiole 2–3 cm, glabrous; leaf blade lanceolate to oblong-lanceolate, 8–12 × 2–4 cm, base cuneate, margin entire, apex acute; lateral veins 4 or 5 pairs, reticulate veins inconspicuous. Cymes terminal and axillary, paniculate, 4–6 cm wide, glabrous; bracts lanceolate, 1.5–2 mm. Flowers sessile. Calyx ca. 1.5 mm; lobes ovate, ciliolate, apex acute. Corolla white, campanulate, ca. 3.5 mm, base ca. 1 mm wide; throat ca. 3 mm wide; lobes oblong, ca. 2 mm, slightly longer than tube, recurved. Filaments ca. 1.5 mm, inserted ca. 1.5 mm above base; anthers ca. 0.5 mm. Style ca. 2.5 mm, branches ca. 1.5 mm. Drupes unknown. Fl. Dec.

• Open forests; ca. 400 m. Hainan (Yaxian Xian).

**14. *Ehretia laevis*** Roxburgh, Pl. Coromandel 1: 42. 1796.

毛萼厚壳树 mao e hou ke shu

*Ehretia laevis* var. *platyphylla* Merrill.

Trees ca. 10 m tall; bark gray-brown; branches gray, scabrous, with elliptic lenticels; branchlets brown, densely pubescent. Petiole 1–2 cm, pubescent or subglabrous; leaf blade ovate-elliptic to obovate, 6–12 × 3–8 cm, abaxially with fascicled short hairs in vein axils, adaxially usually glabrous or pubescent near base, base rounded to broadly cuneate, margin entire, apex obtuse. Cymes terminal and axillary, sparsely dichotomously branched, 5–6 cm wide, densely yellow-brown pubescent, ebracteate. Flowers sessile. Calyx ca. 2 mm; lobes reflexed, oblong, ca. 2 mm, longer than tube. Stamens exerted; filaments subulate, ca. 3 mm, inserted ca. 0.5 mm above base; anthers elliptic, ca. 0.5 mm. Style ca. 2 mm, branches ca. 0.5 mm. Drupes yellow or orange, 3–4 mm in diam.; endocarp wrinkled, divided at maturity into 4 1-seeded pyrenes. Fl. Feb-Apr.  $2n = 26$ .

Forest slopes, roadsides. Hainan (Baoting Xian, upper Chang Jiang) [Bhutan, India, Kashmir, Laos, Myanmar, Pakistan, Vietnam; Australia].

**3. ROTULA** Loureiro, Fl. Cochinch. 1: 121. 1790.

轮冠木属 lun guan mu shu

Shrubs. Stems numerous, prostrate or wandlike, glabrous or sericeous; branches thin, straight. Leaves alternate, fascicled at nodes, short petiolate or sessile, entire or inconspicuously dentate. Cymes terminal, sparse, small. Calyx 5-lobed; lobes overlapping in bud, lanceolate. Corolla purple-red or pink, subcampanulate, 5-lobed; tube short; lobes spreading, overlapping in bud, oblong to orbicular. Stamens included or exerted; filaments glabrous; anthers oblong. Ovary ovoid or oblong, 4-loculed; ovules 1 per locule. Style terminal, undivided; stigma enlarged, somewhat 2-cleft, subpeltate. Drupes red, endocarp well developed, dividing into 4 1-seeded pyrenes. Seeds oblong, without endosperm.

Three species: Brazil, Africa, tropical Asia; one species in China.

**1. *Rotula aquatica*** Loureiro, Fl. Cochinch. 1: 121. 1790.

轮冠木 lun guan mu

*Carmona viminea* (Wallich) G. Don; *Ehretia viminea* Wallich; *Rhabdia viminea* (Wallich) Dalziel & Gibs.

Stems gray or black-gray, glabrous. Petiole 0.5–4 mm; leaf blade oblong or oblanceolate, 0.5–2.5 cm × 2–10 mm, ±

leathery, strigose, base rounded, cuneate to broadly cuneate, margin entire, apex obtuse, mucronate. Corolla 6–7 × 6–7 mm. Fruit yellow- to brownish red, ca. 4 mm in diam., nearly dry.

Stony streamsides, rock crevices. Guangxi (Nanning Shi), Guizhou (Zhenfeng Xian), Yunnan [India, Indonesia, Malaysia, Myanmar, Philippines, Thailand, Vietnam].

**4. CARMONA** Cavanilles, Icon. 5: 22. 1799.

基及树属 ji ji shu shu

Shrubs or small trees. Leaves small, petiolate, alternate on annual twigs, fascicled on dwarf shoots, scabrous, adaxially white spotted, margin coarsely dentate. Inflorescences axillary, usually 2–6-flowered in widely spaced glomerules. Calyx 5-parted; lobes spreading. Corolla white; tube short; throat unappendaged; lobes spreading. Stamens exerted. Style terminal on ovary, 2-cleft nearly to base, ca. as long as corolla, persistent, beaked in fruit; stigmas 2, capitate. Drupes red or yellow, subglobose; endocarp bony, entire at maturity, 4-seeded.

One species: China, Indonesia, Japan; Australia.

**1. *Carmona microphylla*** (Lamarck) G. Don, Gen. Hist. 4: 391. 1837.

基及树 ji ji shu

*Ehretia microphylla* Lamarck, Encycl. Meth. 1: 425. 1783; *Carmona heterophylla* Cavanilles; *E. buxifolia* Roxburgh; *E. buxifolia* var. *latisejala* Gagnepain; *E. dentata* Courchet.

Shrubs 1–3 m tall, much branched; bark brown; branches slender, internodes 1–2 cm, sparsely hirtellous when young; buds light brown, globose, tomentose. Petiole short; leaf blade obovate to spatulate, 1.5–3.5 × 1–2 cm, leathery, abaxially subglabrous, adaxially hirtellous or spotted, base attenuate, margin coarsely crenate, apex rounded to acute. Glomerules spreading, 0.5–1.5 cm wide; peduncle slender, 1–1.5 cm,

pubescent. Pedicel 1–1.5 mm, or ± obsolete. Calyx 4–6 mm, parted nearly to base; lobes linear or linear-oblanceolate, 0.5–0.8 mm, attenuate below middle, spreading hirtellous, densely appressed pubescent inside. Corolla white or slightly reddish, campanulate, 4–6 mm; lobes spreading, oblong, longer than tube. Filaments 3–4 mm, inserted near base of corolla; anthers oblong 1.5–1.8 mm, exerted. Style 4–6 mm, glabrous. Drupes 3–4 mm in diam.; endocarp globose, reticulate-wrinkled, 2–3 mm in diam., apex short beaked.  $2n = 32$ .

Thickets. S Guangdong, Hainan, Taiwan [Indonesia, Japan (Ryukyu Islands); Australia].

Flora of Java treats *Carmona microphylla* as a synonym of *C. retusa* (Vahl) Masamune, based on *Ehretia retusa* Vahl (Symb. Bot. 2: 42. 1791).

**5. COLDENIA** Linnaeus, Sp. Pl. 1: 125. 1753.

双柱紫草属 shuan zhu zi cao shu

*Lobophyllum* F. Mueller.

Herbs annual. Leaves alternate, margin lobed; secondary veins ending in sinuses. Inflorescences generally extra-axillary on leafy twigs or in forks of branches, sometimes glomerate. Flowers sessile or on short pedicels, 4-merous. Calyx 4-lobed. Corolla throat glabrous, naked or with 4 scaly appendages; lobes spreading, overlapping in bud. Ovary ovoid, somewhat 4-lobed, 2-loculed and with 2 ovules per locule, or falsely 4-loculed and with 1 ovule per locule; ovules anatropous. Styles 2, terminal, divided or united to middle; stigmas 2, usually divided. Fruit fleshy or dry, fastigiate or semiglobose, endocarp bony, divided into 4 1-seeded achenelike mericarps; mericarps ± united ventrally or joined to a central extension of receptacle. Seeds with little or no endosperm or not; embryo straight or curved.

One species: Cambodia, China, India, Indonesia, Malaysia, Pakistan, Sri Lanka, Thailand, Vietnam; Africa, Australia, North America, South America.

For a discussion on the generic limits of *Coldenia*, see Richardson (Rhodora 79: 476. 1977).

**1. *Coldenia procumbens* Linnaeus, Sp. Pl. 1: 125. 1753.**

双柱紫草 shuang zhu zi cao

Herbs annual. Stems branched from base; branches prostrate or ascending, 15–40 cm, densely spreading strigose. Lower stem leaves short petiolate, oblong to obovate, 1–2 × 0.5–1.5 cm, asymmetrical, scabrous, strigose, margin coarsely crenate-lobulate; lateral veins 4–6 pairs, prominent abaxially, concave adaxially; upper leaves sessile. Flowers solitary, subsessile. Calyx 1.5–2 mm; lobes lanceolate to ovate-lanceolate, slightly enlarged in fruit, persistent, strigose.

Corolla white, tubular, 2–2.5 mm, glabrous; lobes orbicular, ca. 0.3 mm. Stamens included; filaments ca. 0.3 mm, glabrous, inserted at middle of corolla tube; anthers rounded to broadly ovate, ca. 0.2 mm. Ovary fastigiate, 4-sulcate; stigma obscurely 2-cleft. Fruit broadly triangular, 3–4 mm, glandular pubescent; mericarps wrinkled, spinescent-tuberculate. Fl. Apr, fr. Jun.

Sandy places, beaches, dry cultivated ground. Hainan, Taiwan [Cambodia, India, Indonesia, Malaysia, Pakistan, Sri Lanka, Thailand, Vietnam; Africa, Australia, North America, South America].

**6. HELIOTROPIUM Linnaeus, Sp. Pl. 1: 130. 1753.**

天芥菜属 tian jie cai shu

Herbs annual or perennial, rarely subshrubs, pubescent or strigose, rarely scabrous. Leaves alternate, less often opposite, sessile or petiolate. Cymes terminal, rarely axillary, unilateral, scorpioid, bracteate or not. Calyx 5-parted. Corolla white or light bluish purple, less often yellow, cylindrical or funnelform, strigose outside, glabrous and rarely appressed pubescent inside; throat frequently pubescent; limb 5-parted; lobes orbicular, sometimes linear, margin with folds or undulate. Filaments extremely short; anthers included. Ovary completely or incompletely divided into 4 lobes; ovules 4. Style terminal; stigma conical or ringlike. Fruit nutletlike dry drupes, without evident mesocarp at maturity, endocarp bony, dividing into 4 1-seeded or 2 2-seeded mericarps. Seeds straight or curved, usually with a thin endosperm.

About 250 species: tropical and temperate regions; ten species in China.

*Heliotropium ovalifolium* Forsskål var. *depressum* (Chamisso) Merrill is not included here because no material was available for study.

1a. Corolla blue, violet, or purple.

- 2a. Leaf blade decurrent to petiole, lateral veins 5–7 pairs; cymes solitary; mericarps with longitudinal ribs ..... 10. *H. indicum*
- 2b. Leaf blade not decurrent to petiole, lateral veins 7–9 pairs; cymes paniculate or corymbose; mericarps without longitudinal ribs ..... 9. *H. pseudoindicum*

1b. Corolla white.

- 3a. Stigma short conical, not longer than style.
  - 4a. Shrubby perennials; flowers sessile; stigma ca. 1/2 as long as style ..... 2. *H. arguzioides*
  - 4b. Annuals; flowers pedicellate; stigma ca. as long as style.
    - 5a. Style glabrous; mericarps narrowly ovate, 3–3.5 mm ..... 8. *H. acutiflorum*
    - 5b. Style densely white pubescent; mericarps linear-oblong, complanate, ca. 5 mm ..... 7. *H. micranthum*
- 3b. Stigma long conical, longer than style.
  - 6a. Leaf blade elliptic to elliptic-ovate or obovate, 3–6 cm, sparsely strigose; mericarps glabrous or strigose.
    - 7a. Mericarps glabrous, ± distinctly tuberculate; stigma elongated, deeply 2-cleft at apex ..... 5. *H. europaeum*
    - 7b. Mericarps retrorsely strigose, indistinctly rugose and warty; stigma not 2-cleft at apex ..... 6. *H. lasiocarpum*
  - 6b. Leaf blade narrowly oblong to ovate or linear-lanceolate, 0.3–2 cm, densely strigose; mericarps hairy.
    - 8a. Cymes slender, 2–6 cm; flowers sparse, in 1 row ..... 3. *H. strigosum*
    - 8b. Cymes stout, 0.8–2.5 cm; flowers crowded, in 2 rows.
      - 9a. Bracts lanceolate; fruit densely antrorse hirtellous at apex ..... 1. *H. marifolium*
      - 9b. Bracts elliptic to ovate; fruit appressed pubescent above middle ..... 4. *H. formosanum*

**1. *Heliotropium marifolium* Retzius, Observ. Bot. 2: 8. 1781.**

大苞天芥菜 da bao tian jie cai

Subshrubs 10–15 cm tall, much branched; branches spreading or prostrate, sparsely hirtellous. Leaves crowded, ± opposite when young, alternate in age, ± sessile, narrowly oblong to lanceolate, 0.8–1.5 cm × 2–3 mm, densely antrorse appressed hirtellous, base cuneate, apex acute. Cymes

terminal, scorpioid, 1–2.5 cm; bracts spreading, lanceolate, 3–4 mm. Flowers sessile, crowded. Calyx 2.5–4 mm, densely hispid outside, glabrous below middle inside; lobes lanceolate to ovate-lanceolate, slightly enlarged in fruit. Corolla white, tubular, 2–3 mm, base ca. 1 mm wide; throat constricted to 0.5 mm; limb ca. 1 mm wide, densely hispid outside, slightly exceeding calyx or not; lobes ovate, ca. 0.5 mm. Filaments extremely short, inserted near base of corolla tube; anthers ovate-lanceolate, ca. 0.5 mm, apices thickened,

coherent. Ovary globose. Style less than 0.5 mm; stigma ringlike at base, conical at apex. Fruit globose, ca. 2 mm in diam., densely pale yellow hirtellous, divided at maturity into 4 1-seeded mericarps; mericarps ca. 1.5 mm, white spotted adaxially near middle. Fl. Jun.

Arid, sandy beaches. Hainan [Cambodia, India, Indonesia, Malaysia, Pakistan, Sri Lanka, Thailand, Vietnam].

**2. *Heliotropium arguzioides*** Karelin & Kirilov, Bull. Soc. Imp. Naturalistes Moscou 15: 406. 1842.

新疆天芥菜 xīn jiāng tiān jiē cài

*Heliotropium radula* Fischer & C. A. Meyer; *H. xinjiangense* Y. L. Liu.

Herbs perennial, shrubby, 25–30 cm tall. Stems erect or ascending, branched from base, densely pubescent, with ribs and flaking white bark; branches crowded. Petiole short, 3–5 mm, or subsessile, white pubescent; leaf blade gray-green, oblong-elliptic to oblong or ovate, 1–2 × 0.5–1 mm, abaxially soft pubescent, adaxially scabrous, densely appressed hirsute and hirtellous, base rounded to broadly cuneate, margin subrevolute, apex obtuse to acute; lateral veins 2 or 3 pairs. Cymes terminal and axillary, scorpioid, 1–2.5 cm wide, pubescent, ebracteate. Flowers sessile. Calyx 1.5–2 mm, parted nearly to base, densely gray pubescent outside, glabrous inside; lobes narrowly ovate or oblong. Corolla white, tubular, 2–3.5 mm, base ca. 1 mm wide; limb ca. 1 mm wide, densely antrorse pubescent outside, glabrous inside; lobes orbicular, margin crispate. Filaments extremely short, inserted above middle of corolla tube; anthers ovate, ca. 0.5 mm. Ovary ellipsoid, glabrous. Style ca. 1 mm, glabrous; stigma short conical, 0.5–2 mm, glabrous, base ringlike. Fruit ellipsoid, divided at maturity into 4 1-seeded mericarps; mericarps ovate, 2–3 mm, densely villous. Fl. and fr. Aug.

Dunes. N Xinjiang (Huocheng Xian) [Kazakhstan, Russia, Uzbekistan].

*Heliotropium xinjiangense* differs from *H. arguzioides* only by having a longer conical stigma 1–2 mm (instead of ca. 0.5 mm). However, since stigma length is variable and unreliable, the two are considered conspecific.

**3. *Heliotropium strigosum*** Willdenow, Sp. Pl. 1(2): 743. 1798.

细叶天芥菜 xì yè tiān jiē cài

*Lithospermum chinense* Hooker & Arnott.

Herbs perennial, rarely annual, 15–30 cm tall. Stems numerous, slender, prostrate or ascending, base woody, densely appressed strigose. Leaves crowded; petiole 0.5–1 mm, or ± sessile; leaf blade linear-lanceolate, 3–10 × 1–1.5 mm, appressed strigose, margin usually revolute; midvein prominent abaxially, concave adaxially, without evident lateral veins. Cymes scorpioid, slender, 2–6 cm; bracts 1–3 mm. Flowers sparse, unilateral. Calyx 2–3 mm; lobes lanceolate, sparsely strigose. Corolla white, tubular or funnelform, 3–4 mm, widest at middle, ca. 1 mm wide; throat constricted, glandular, sparsely pubescent; limb 3.5–4 mm

wide; lobes suborbicular, with folds above middle, densely hispid outside. Anthers ovate-lanceolate, 0.5–0.7 mm, apices thickened, coherent. Ovary globose, glabrous. Style short, evident; stigma conical, base ringlike, ca. 3 mm wide, apex short pubescent. Fruit compressed globose, ca. 2 mm in diam., densely strigose-hirtellous, divided at maturity into 4 1-seeded mericarps; mericarps trigonous-ovate, ca. 1 mm. Fl. and fr. Jul-Sep.  $2n = 22, 26, 32, 64$ .

Sandy places, woods on coastal slopes. Fujian, Guangdong [Afghanistan, Bhutan, Cambodia, India, Kashmir, Laos, Myanmar, Nepal, Pakistan, Thailand, Vietnam; Africa, Australia].

**4. *Heliotropium formosanum*** I. M. Johnston, J. Arnold Arbor. 32: 114. 1951.

台湾天芥菜 tai wān tiān jiē cài

Herbs perennial, ascending or prostrate, short gray strigose. Stems 10–25 cm tall, base usually woody; branches sparse, slender. Leaves crowded; petiole of basal leaves ca. 1 mm, other leaves ± sessile; leaf blade elliptic to ovate, 3–4 × 1–2 mm, base obtuse to rounded, apex acute; midvein prominent adaxially. Inflorescences terminal, obscurely scorpioid, 0.8–1.5 cm, 4–8-flowered; bracts ovate to elliptic, 2–3 mm. Flowers crowded. Calyx 2–3 mm, strigose outside, subglabrous inside; lobes unequal, 0.5–1.2 mm wide, slightly surpassing corolla tube. Corolla white, 3.5–4 mm; tube ca. 1.5 mm, middle 0.8–1 mm wide; throat slightly contracted, densely tomentose; limb to 4 mm wide; lobes ovate-triangular, ca. 1 mm wide, with a wide obtuse fold between lobes. Filaments extremely short, inserted 0.4–0.6 mm above base of corolla tube; anthers ovate-lanceolate, 0.6–0.7 mm, apex coherent. Ovary smooth. Style ca. 0.5 mm; stigma long conical, 0.7–0.8 mm. Fruit convex, 1–1.2 mm, appressed pubescent above middle; mericarps with an aperture adaxially at middle, ribs with a scar at middle.

• Taiwan.

**5. *Heliotropium europaeum*** Linnaeus, Sp. Pl. 1: 130. 1753.

天芥菜 tiān jiē cài

Herbs annual, 20–50 cm tall. Stems erect or ascending, branched from base, strigose or hirtellous. Petiole 1–4 cm; leaf blade elliptic to elliptic-ovate, 1.5–4 × 1–2.5 cm, abaxially gray-green and densely hirtellous, adaxially green and sparsely hirtellous, base widely cuneate to rounded, apex obtuse to acute. Cymes terminal and axillary, scorpioid, simple or dichotomously branched, 2–4 cm. Flowers sessile. Calyx lobes ovate to ovate-lanceolate, 2–3 × 1–1.5 mm, not enlarged in fruit, strigose. Corolla white, 4–5 mm, base 1.5–2 mm wide; throat slightly contracted; limb (2–)3–4 mm wide; lobes rounded, ca. 1.5 mm wide, short strigose outside, glabrous inside. Anthers ovate-oblong, ca. 1 mm, without filaments, attached ca. 1 mm above base of corolla tube. Ovary globose, 0.5–0.7 mm in diam. Style short; stigma long conical, deeply 2-cleft, 1.2–1.5 mm, ringlike portion glabrous, apex short strigose. Fruit 2.5–3 mm in diam.; mericarps ovate, ca. 2 mm, ± distinctly tuberculate, glabrous. Fl. and fr. Jul-Sep.  $2n = 24, 32, 48$ .

Gravelly deserts, river banks, valleys; 100–800 m. Naturalized

in W Gansu, Xinjiang [Afghanistan, India, Pakistan, Russia; N Africa, SW Asia, S Europe].

**6. *Heliotropium lasiocarpum*** Fischer & C. A. Meyer, Index Sem. Hort. Pétrap. 4: 38. 1837.

毛果天芥菜 mao guo tian jie cai

*Heliotropium eichwaldii* Steudel var. *lasiocarpum* (Fischer & C. A. Meyer) C. B. Clarke; *H. ellipticum* Ledebour var. *lasiocarpum* (Fischer & C. A. Meyer) Popov; *H. europaeum* var. *lasiocarpum* (Fischer & C. A. Meyer) Kazmi.

Herbs annual, ca. 40 cm tall. Stems erect, sometimes woody at base, low branched, densely spreading or curved, white pubescent or sometimes hirtellous. Petiole 1–3 cm, densely pubescent or hirtellous; leaf blade obovate to elliptic-ovate, 2–6 × 1.5–3.5 cm, white pubescent or hirtellous, base widely cuneate to rounded, margin entire, apex obtuse; lateral veins 3 or 4 pairs, usually densely pubescent. Cymes terminal and axillary, scorpioid, 8–15 cm; branches usually paired, rarely ternate, ebracteate. Flowers sessile. Calyx parted nearly to base; lobes lanceolate, 3–3.5 × 0.5–1 mm, densely pubescent. Corolla white, tubular-campanulate, 4–4.5 mm, pubescent outside, glabrous inside; lobes rounded, 1–1.5 mm wide, with an erect or spreading fold between lobes. Anthers sessile, 1–1.2 mm, inserted ca. 1 mm above base, apex abruptly attenuate. Ovary globose, ca. 1 mm in diam., glabrous. Style extremely short or obscure; stigma ringlike, ca. 5 mm wide, sterile upper portion ca. 1 mm, 2-cleft. Fruit 2–2.5 mm in diam., dividing into 4 1-seeded mericarps; mericarps ovate, densely short strigose, sparsely tuberculate. Fl. and fr. Jun.

Deserts at low elevations, gravelly river marshes, meadows. N Henan, SW Shanxi, N Xinjiang [India, Kashmir, Kazakhstan, Kyrgyzstan, Pakistan, Russia, Tajikistan, Turkmenistan, Uzbekistan; SW Asia].

**7. *Heliotropium micranthum*** (Pallas) Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg Divers Savans 7: 399. 1851.

小花天芥菜 xiao hua tian jie cai

*Onosma micranthos* Pallas, Reise Russ. Reich. 2: 734. 1776; *Beruniella micrantha* (Pallas) K. Z. Zakirov & M. M. Nabiev.

Herbs perennial, 10–15 cm tall. Stems erect, base much branched, glabrous or sparsely hirtellous. Petiole 0.5–2 cm, sparsely hirtellous; leaf blade ovate-oblong to oblong-elliptic, 1.5–4.5 × 0.5–1.5 cm, abaxially gray-green, densely hirtellous, hairs discoid at base, adaxially green and subglabrous or sparsely hirtellous, base widely cuneate to rounded, apex obtuse. Cymes scorpioid, terminal and axillary, in large panicles. Pedicel slender, 2–4 mm, to 1 cm after anthesis. Calyx parted nearly to base, 2.5–3 mm, to 5 mm in fruit, sparsely hirtellous; lobes linear to oblong, apex acute. Corolla white, 2.5–3.5 mm, ca. as long as or slightly longer than calyx, base retrorse pubescent outside, glabrous inside; lobes lanceolate, ca. 0.5 mm, included, with a mucro between lobes. Filaments obscure, inserted at middle of corolla tube; anthers ovate-oblong, ca. 1 mm. Ovary ellipsoid, glabrous.

Style ca. as long as stigma, ca. 0.7 mm, with many retrorse white hairs; stigma conical, densely white pubescent. Fruit oblong, divided at maturity into 4 1-seeded mericarps; mericarps complanate, linear-oblong, ca. 5 mm, sericeous-cottony. Fl. and fr. Jun.

Dunes and slopes in desert regions. N Xinjiang [Kazakhstan, Kyrgyzstan, Russia, Tajikistan, Turkmenistan, Uzbekistan; Europe].

**8. *Heliotropium acutiflorum*** Karelin & Kirilov, Bull. Soc. Imp. Naturalistes Moscou 15: 406. 1842.

尖花天芥菜 jian hua tian jie cai

Herbs perennial, 5–15 cm tall. Stems branched from base, spreading strigose; branches usually erect. Petiole 1–2 cm, densely strigose; leaf blade narrowly ovate to ovate, 1–2.5 × 1–1.5 cm, strigose or hirtellous, base broadly cuneate to rounded, margin entire, apex obtuse. Cymes scorpioid, 1–3 cm, usually 3–7-flowered. Pedicel slender. Calyx lobes oblong-ovate, 2–2.5 mm, slightly enlarged in fruit, strigose outside, glabrous inside. Corolla tubular, ca. 3 mm, short strigose outside, glabrous inside; throat with 5 terete appendages; lobes erect to spreading, linear, ca. 0.5 mm. Filaments inserted ca. 1 mm above base of corolla tube; anthers oblong, ca. 1 mm. Ovary subglobose ca. 0.8 mm in diam., glabrous. Style 0.6–0.8 mm, ca. as long as stigma, glabrous; stigma short conical to subellipsoid, short pubescent. Mericarps narrowly ovate, 3–3.5 mm, densely white villous. Fl. and fr. May–Jun.

Dunes, sandy ground. N Xinjiang [Kazakhstan, Kyrgyzstan, Russia, Tajikistan, Turkmenistan, Uzbekistan].

**9. *Heliotropium pseudindicum*** H. Chuang, Acta Bot. Yunnan 5(1): 59. 1983.

拟大尾摇 ni da wei yao

Herbs erect, 20–50 cm tall. Stems stout, much branched, hirtellous, woody at base. Petiole 5–10 mm, hirtellous; leaf blade elliptic, 4–8 × 1–2.4 cm, usually hirtellous, base cuneate, margin entire, apex acute to acuminate; lateral veins 7–9 pairs, inconspicuous. Cymes terminal, paniculate or corymbose, scorpioid, 5–9 × 6–9 cm. Flowers in 2 ranks along 1 side of rachis. Calyx green; lobes lanceolate to narrowly lanceolate, 2.5–3 mm, densely hirtellous outside. Corolla purple, 6–7 mm, sparsely pubescent outside; tube cylindrical, 4–5 mm, elongated at anthesis; lobes of limb rounded. Filaments short, slender, inserted above base. Style terete, slightly longer than ovary; stigma conical, ca. 1 mm. Mericarps pale gray-green, subreniform, ca. 1 mm, glabrous, with obscure dots, without ribs.

• Cultivated ground; ca. 600 m. Yunnan (Mengla Xian).

**10. *Heliotropium indicum*** Linnaeus, Sp. Pl. 1: 130. 1753.

大尾摇 da wei yao

Herbs annual, 20–50 cm tall. Stems erect, stout, much branched, strigose. Leaves alternate or subopposite; petiole 2–5 cm; leaf blade 3–9 × 2–4 cm, pubescent or strigose, base rounded or truncate, decurrent to petiole, margin undulate, apex acute; lateral veins 5–7 pairs. Cymes solitary, scorpioid,

5–15 cm, ebracteate. Flowers sessile, crowded. Calyx lobes lanceolate, 1.5–2 mm, strigose. Corolla light blue or blue-purple, salverform, 3–4 mm, base ca. 1 mm wide; throat contracted to ca. 0.5 mm; limb 2–2.5 mm wide; lobes rotund, ca. 1 mm wide, margin crispate. Anthers narrowly ovate, ca. 0.5 mm, inserted ca. 1 mm above base. Ovary glabrous. Style ca. 0.5 mm; stigma conical, pubescent. Fruit ribbed, 3–3.5 mm, glabrous or nearly so, deeply 2-cleft into mericarps each divided into 2 1-seeded pyrenes; mericarps

longitudinally ribbed. Fl. and fr. Apr-Oct.  $2n = 22, 24, 44, 64$ .

Hills, river banks, open waste places; 0–700 m. Widely scattered. Fujian, Hainan, Nanhai Zhudao, Taiwan, SW Yunnan [Cambodia, India, Indonesia, Japan (Ryukyu Islands), Laos, Malaysia, Myanmar, Thailand, Vietnam; Africa, North America, Pacific Islands, South America].

Entire plant is used in herbal medicine.

## 7. TOURNEFORTIA Linnaeus, Sp. Pl. 1: 140. 1753.

紫丹属 zi dan shu

*Argusia* Boehmer ex Ludwig; *Argusia* Ammann ex Steudel; *Messerschmidia* Linnaeus ex Hebenstreit.

Shrubs, climbing shrubs, trees, or herbs. Leaves alternate, petiolate, entire. Cymes terminal or axillary, corymbose, ebracteate. Calyx 4- or 5-parted, not changing in fruit; lobes narrow. Corolla white or pale green, usually funnelform; tube pubescent outside, usually exceeding calyx; throat unappendaged; lobes 4 or 5, overlapping or valvate in bud, spreading at anthesis. Filaments short, inserted on corolla tube; anthers ovate to oblong, mucronate or obtuse at apex. Disc slightly convex or sometimes nearly cupular. Ovary 4-loculed; ovules 1 per locule, pendulous. Style terminal; stigma entire or 2-cleft, base fleshy, ringlike, inflated. Drupes with watery, sticky, or corky mesocarp, endocarp divided at maturity into 2 2-seeded or 4 1-seeded mericarps, sometimes 1 seed sterile. Seeds oblique; cotyledons ovate or elliptic.

About 150 species: tropical and subtropical regions; four species in China.

*Argusia* (including *Messerschmidia*) has often been regarded as a distinct genus of three species of seashore plants. It is distinguished from *Tournefortia* by the corky mesocarp, which is an adaptation to dispersal by seawater. True *Tournefortia* has fleshy fruit, and none of its species is a seashore plant. For a detailed discussion of the generic limits of *Argusia* and *Tournefortia*, see Al-Shehbaz (J. Arnold Arbor., suppl. ser., 1: 1–169. 1991).

1a. Mesocarp watery, sticky; climbing shrubs, rarely trees.

2a. Fruit divided at maturity into 4 1-seeded mericarps; style short ..... 1. *T. sarmentosa*

2b. Fruit divided at maturity into 2 2-seeded mericarps; style absent ..... 2. *T. montana*

1b. Mesocarp corky; trees, shrubs, or herbs.

3a. Trees or shrubs; leaf blade oblanceolate, 7–13 cm; flowers sessile, in scorpioid cymes; fruit ca. 5 mm in diam., glabrous, globose ..... 3. *T. argentea*

3b. Herbs; leaf blade linear to lanceolate, less than 5 cm; flowers pedicellate, in widely spaced unilateral cymes; fruit 7–9 mm in diam., scabrous, densely strigose, apex concave ..... 4. *T. sibirica*

1. *Tournefortia sarmentosa* Lamarck, Tabl. Encycl. 2(1): 416. 1792.

紫丹 zi dan

台湾紫丹 tai wan zi dan

*Tournefortia boniana* Gagnepain; *T. brachyantha* Merrill & Chun; *T. gaudichaudii* Gagnepain; *T. samsonii* Hance.

Shrubs climbing, 1–5 m tall. Petiole ca. 1 cm; leaf blade ovate to elliptic or lanceolate, usually densely minutely tuberculate, 6–10 × 2–5 cm, abaxially spreading short pubescent or subglabrous, adaxially hirtellous or strigose, base obtuse to rounded, apex acuminate. Cymes terminating leafy branches, sparsely branched; branches slender, usually 1–3 cm. Flowers sessile. Calyx 1–2 mm, strigose; lobes lanceolate-ovate to lanceolate. Corolla white, 3–4 mm; throat ca. 2.5 mm wide, sparsely strigose; lobes rounded, ca. 1.5 mm wide. Anthers sessile, less than ca. 1 mm, inserted ca. 1 mm above base of corolla tube. Ovary glabrous or apex sparsely short pubescent. Style short; stigma globose to terete, ca. 2 × as wide as style, apex obscurely 2-cleft. Fruit white, ca. 5 mm, divided at maturity into 4 1-seeded mericarps.

Shrubs climbing, 1–2 m tall; branchlets pubescent. Petiole 5–10 mm; leaf blade lanceolate to ovate-lanceolate, 8–14 × 1.5–4 cm, sparsely strigose, base cuneate to rounded, apex acuminate to caudate-acute. Inflorescences terminating leafy branches, with sparse branches, 2–15 × 4–10 cm, strigose. Flowers unilateral, sessile. Calyx parted to middle or slightly below, ca. 2 mm, strigose; lobes lanceolate to triangular-lanceolate. Corolla unknown. Stigma sessile at apex of globose ovary. Fruit subglobose, ca. 5 mm in diam.; endocarp divided at maturity into 2 2-seeded mericarps, usually 1 seed sterile.

Forests. Guangdong and coastal islands, Yunnan [Vietnam].

Taiwan [Indonesia, Philippines; NE Australia].

3. *Tournefortia argentea* Linnaeus f., Suppl. Pl. 133. 1781.

银毛树 yin mao shu

2. *Tournefortia montana* Loureiro, Fl. Cochinch. 1: 122. 1790.

*Argusia argentea* (Linnaeus f.) Heine; *Messerschmidia argentea* (Linnaeus f.) I. M. Johnston; *Tournefortia arborea*

Blanco.

Shrubs 1–5 m tall or small trees; branchlets stout, densely rust-colored or white pubescent. Leaves terminating branches, oblanceolate to obovate, 7–13 × 2–4 cm, densely covered with yellowish white filiform hairs, base attenuate, apex obtuse to rounded. Inflorescences terminal, corymbose, 5–10 cm in diam., densely rust-colored pubescent; cymes scorpioid. Calyx fleshy, sessile, 1.5–2 mm, 5-parted; lobes oblong or obovate to rounded, densely rust-colored pubescent outside, pubescent only at base or subglabrous inside, ca. 1/2 as long as corolla. Corolla white, tubular, 2.5–3 mm; lobes spreading, ovate, ca. 2 mm, longer than tube. Stamens somewhat exerted; filaments inserted ca. 4 mm above base of corolla tube; anthers ovate-oblong, ca. 1 mm. Ovary subglobose, glabrous. Style obscure; stigma 2-cleft, base ringlike, inflated. Fruit subglobose, ca. 5 mm in diam., glabrous. Fl. and fr. Apr–Jun.

Sandy beaches. Hainan, Taiwan [Indonesia, Japan, Philippines, Sri Lanka, Vietnam; Pacific Islands (New Caledonia, Polynesia)].

#### 4. *Tournefortia sibirica* Linnaeus, Sp. Pl. 1: 141. 1753.

砂引草 sha yin cao

Herbs perennial, 10–30 cm tall. Rhizomes creeping. Stems single or several, cespitose, erect, or ascending, usually branched, densely strigose or white villous. Leaves sessile or nearly so, lanceolate or oblanceolate to oblong or linear to linear-lanceolate, 1–5 cm × 6–10 mm, densely strigose or villous, base cuneate to rounded, apex acuminate to obtuse. Cymes terminal, scorpioid, 1.5–4 cm wide. Flowers pedicellate. Calyx lobes lanceolate, 3–4 mm, densely strigose. Corolla yellowish white, campanulate, 1–1.3 cm; tube longer than lobes, densely strigose outside; lobes ovate to oblong, recurved. Filaments ca. 0.5 mm, inserted at middle of corolla tube; anthers oblong, 2.5–3 mm, apex mucronate. Ovary slightly 4-cleft, 0.7–0.9 mm, glabrous. Style ca. 0.5 mm, thin; stigma slightly 2-cleft, 0.7–0.8 mm. Fruit elliptic to ovoid, 7–9 mm in diam., scabrous, densely strigose, apex concave; endocarp longitudinally ribbed, divided at maturity into 2 2-seeded pyrenes. Fl. May, fr. Jul.  $2n = 26$ .

Arid slopes, sandy areas; 0–1900 m. Gansu, Hebei, Heilong-

jiang, Henan, Gansu, Liaoning, Nei Mongol, Ningxia, Shaanxi, Shandong, Shanxi [Japan, Kazakhstan, Korea, Mongolia, Russia; SW Asia, SE Europe].

- 1a. Leaf blade lanceolate or oblanceolate to oblong ..... 4a. var. *sibirica*
- 1b. Leaf blade linear to linear-lanceolate ..... 4b. var. *angustior*

#### 4a. *Tournefortia sibirica* var. *sibirica*

砂引草 (原变种) sha yin cao (yuan bian zhong)

*Argusia sibirica* (Linnaeus) Dandy; *Messerschmidia arguzia* Linnaeus; *M. sibirica* (Linnaeus) Linnaeus; *M. sibirica* var. *latifolia* (A. de Candolle) H. Hara; *Tournefortia arguzia* Roemer & Schultes; *T. arguzia* var. *latifolia* de Candolle; *T. sibirica* var. *grandiflora* H. Winkler.

Leaf blade lanceolate to oblanceolate or oblong, 1–5 cm × 6–10 mm.

Sandy beaches, arid deserts and slopes; 0–1900 m. Gansu, Hebei, Henan, Ningxia, Shaanxi, Shandong [Japan, Korea, Mongolia, Russia; SW Asia, SE Europe].

#### 4b. *Tournefortia sibirica* var. *angustior* (A. de Candolle) G. L. Chu & M. G. Gilbert in G. L. Chu, Kamelin, R. R. Mill, & M. G. Gilbert, Novon 5: 17. 1995.

细叶砂引草 xi ye sha yin cao

*Tournefortia arguzia* var. *angustior* A. de Candolle, Prodr. 9: 514. 1845; *Messerschmidia sibirica* subsp. *angustior* (A. de Candolle) Kitagawa; *M. sibirica* var. *angustior* (A. de Candolle) W. T. Wang; *M. sibirica* var. *rosmarinifolia* (Turczaninow) Popov; *T. sibirica* var. *rosmarinifolia* Turczaninow.

Leaf blade linear to linear-lanceolate.

Arid slopes, sandy river banks; 500–1900 m. Hebei, Heilongjiang, Henan, Liaoning, Nei Mongol, Ningxia, Shaanxi, Shandong, Shanxi [Kazakhstan, Russia].

## 8. LITHOSPERMUM Linnaeus, Sp. Pl. 1: 132. 1753.

紫草属 zi cao shu

*Buglossoides* I. M. Johnston.

Herbs annual or perennial, short strigose. Leaves alternate. Cymes terminal or flowers solitary, bracteate. Calyx 5-parted nearly to base, slightly enlarged in fruit. Corolla white, yellow, or violet, actinomorphic, funnelform or salverform; throat with appendages or bands of hairs, or longitudinally crispate; limb usually campanulate, 5-parted; lobes spreading. Stamens included; filament very short; anthers oblong-linear, apex obtuse, mucronulate. Style filiform, not exerted; stigma entire or indistinctly 2-cleft, capitate. Gynobase flat. Nutlets white or gray, ovoid, smooth, shiny or tuberculate; attachment scar at base adaxially.

About 50 species: Africa, Asia, Europe, North America, South America; five species in China.

The genus is here treated in the broad sense. Species 3 and 4 are frequently placed in *Buglossoides*.

- 1a. Corolla more than 1.5 cm, violet, blue-purple, or purple-red.
- 2a. Leaf blade linear to linear-lanceolate, 4–15 cm, crowded; persistent; stems sheathed by overlap-

- ping leaf bases; rhizomes absent ..... 5. *L. hancockianum*  
 2b. Leaf blade oblanceolate to spatulate, 3–6 cm, sparsely arranged; stems without sheathing leaf  
 bases; rhizomes present ..... 4. *L. zollingeri*  
 1b. Corolla less than 1 cm, white or pale yellow-green (sometimes blue in *L. arvense*).  
 3a. Herbs annual; nutlets triangular-ovoid, gray-brown, finely tuberculate ..... 3. *L. arvense*  
 3b. Herbs perennial; nutlets ovoid, white or slightly yellowish brown, smooth, shiny.  
 4a. Corolla 7–9 mm, tube ca. as long as limb, lobes broadly ovate, ca. as long as wide, throat  
 appendages glabrous; roots with a copious purple dye ..... 1. *L. erythrorhizon*  
 4b. Corolla 4–6 mm, tube ca. 2 × as long as limb, lobes oblong-ovate, longer than wide, throat  
 appendages short pubescent; roots with little or no purple dye ..... 2. *L. officinale*

**1. *Lithospermum erythrorhizon*** Siebold & Zuccarini, Abh. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. 4(3): 149. 1846.

紫草 zi cao

*Lithospermum officinale* Linnaeus subsp. *erythrorhizon* (Siebold & Zuccarini) Handel-Mazzetti.

Herbs perennial. Roots dark red, with a copious purple dye. Stems usually 1–3, erect, appressed or spreading, branching distally, 40–90 cm tall, short strigose; branches ascending, frequently slightly curved. Leaves sessile, ovate-lanceolate to broadly lanceolate, 3–8 × 0.7–1.7 cm, short strigose, base attenuate, apex acuminate; veins prominent abaxially, more densely strigose. Inflorescences terminal, 2–6 cm, elongated in fruit; bracts similar to leaves but smaller. Calyx lobes linear, ca. 4 mm, to 9 mm in fruit, short strigose outside. Corolla white, 7–9 mm, sparsely pubescent outside; tube ca. 4 mm; throat appendages semiglobose, glabrous; limb ca. as long as tube; lobes spreading, broadly ovate, 2.5–3 mm, margin entire or subundulate, apex sometimes retuse. Stamens inserted slightly above middle of corolla tube; filaments ca. 0.4 mm; anthers 1–1.2 mm. Style 2.2–2.5 mm. Nutlets white or pale yellowish brown, ovoid, ca. 3.5 mm, smooth, shiny, concave adaxially with center line forming a longitudinal groove. Fl. and fr. Jun–Sep.  $2n = 28$ .

Meadows on slopes. SE Gansu, N Guangxi, Guizhou, Hebei, Henan, Hubei, Hunan, Jiangxi, Liaoning, Shaanxi, Shandong, Shanxi, Sichuan [Japan, Korea, E Russia].

The roots are used in Chinese medicine.

**2. *Lithospermum officinale*** Linnaeus, Sp. Pl. 1: 132. 1753.

小花紫草 xiao hua zi cao

Herbs perennial; most parts short strigose. Roots containing little purple dye when young. Stems usually single, erect, to 1 m tall, frequently much branched at apex. Leaves sessile, lanceolate to ovate-lanceolate, 3–8 × 0.5–1.5 cm, base cuneate to attenuate, apex short acuminate; veins prominent abaxially, more densely strigose along veins. Inflorescences on upper stems and branches, to 15 cm in fruit; bracts similar to leaves but smaller. Calyx lobes linear, ca. 5–7 mm in fruit. Corolla white or pale yellow, 4–6 mm; tube ca. 2 × as long as limb; throat with 5 trapeziform, densely short pubescent appendages ca. 0.4 mm; lobes of limb erect, oblong-ovate, ca. 1.5 mm, margin undulate. Stamens inserted at middle of corolla tube; filaments ca. 0.4 mm; anthers ca. 1.2 mm. Stigma capitate. Nutlets white or yellowish brown, ovoid, ca. 3 mm, smooth, shiny, concave adaxially with center line forming a longitudinal groove. Fl. and fr. Jun–Aug.  $2n = 28$ ,

56.

Meadows on slopes, forest margins. C Gansu, Nei Mongol, Ningxia, N Xinjiang [Afghanistan, Bhutan, N India, Nepal, Russia; Europe, SW and W Asia].

**3. *Lithospermum arvense*** Linnaeus, Sp. Pl. 1: 132. 1753.

田紫草 tian zi cao

*Buglossoides arvensis* (Linnaeus) I. M. Johnston; *Rhytispermum arvense* (Linnaeus) Link.

Herbs annual. Roots with purple dye. Stems usually single, branched from base or only above, 15–30 cm tall, short strigose. Leaf blade oblanceolate to linear, 2–4 cm × 3–7 mm, short strigose, apex acute. Cymes terminal, to 10 cm; bracts same shape as leaves but smaller. Flowers sparse, short pedicellate. Calyx lobes usually erect, linear, 4–5.5 mm, to 1.1 cm in fruit, short strigose on both sides, base becoming slightly hardened. Corolla white, sometimes blue or light blue, salverform; tube ca. 4 mm, sparsely pubescent outside; throat with 5 bands of hair extending to tube; limb ca. 1/2 as long as tube; lobes somewhat unequal, erect to slightly spreading, ovate or oblong, ca. 1.5 mm. Stamens attached below middle of tube; anthers oblong, ca. 1 mm. Style 1.5–2 mm; stigma capitate. Nutlets gray-brown, triangular-ovoid, ca. 3 mm, finely tuberculate. Fl. and fr. Apr–Aug.  $2n = 14, 28, 36, 42$ .

Hills, pastures, mountain slopes, margins of cultivated ground. Anhui, Gansu, Hebei, Heilongjiang, Hubei, Jiangsu, Jilin, Liaoning, Shaanxi, Shandong, Shanxi, Xinjiang, Zhejiang [Afghanistan, N India, Japan, Kashmir, Kazakhstan, Korea, Kyrgyzstan, Pakistan, Russia, Tajikistan, Turkmenistan, Uzbekistan; SW Asia, Europe].

A highly variable species with several infraspecific taxa recognized in Europe.

**4. *Lithospermum zollingeri*** A. de Candolle, Prodr. 10: 587. 1846.

梓木草 zi mu chao

*Buglossoides zollingeri* (A. de Candolle) I. M. Johnston.

Herbs perennial. Rhizomes creeping, to 30 cm. Roots brown, containing purple dye. Stems erect, 5–25 cm tall. Basal leaves sparsely arranged, short petiolate, oblanceolate to spatulate, 3–6 × 0.8–1.8 cm, short strigose, abaxially more densely strigose; stem leaves sessile, same shape as basal leaves but smaller, base attenuate, apex acute or obtuse. Inflorescences terminal, 2–5 cm, 1- to several flowered; bracts

leaflike. Pedicel short. Calyx ca. 6.5 mm; lobes linear-lanceolate, pubescent on both sides. Corolla blue or bluish purple, 1.5–1.8 cm, sparsely pubescent outside; tube and limb without a conspicuous border; throat with 5 longitudinal pleats extending to tube, ca. 4 mm, pleats slightly thickened and papillate; limb ca. 1 cm wide; lobes subequal, broadly obovate, 5–6 mm, margin entire, without veins. Stamens attached below pleats; anthers 1.5–2 mm. Style ca. 4 mm; stigma capitate. Nutlets white or light yellowish brown, oblique ovoid, 3–3.5 mm, smooth, shiny, concave adaxially, with center line forming a longitudinal groove. Fl. and fr. May–Aug.  $2n = 16$ .

Hills, mountain slopes, thickets. Anhui, SE Gansu, Guizhou, Jiangsu, Shaanxi, Sichuan, Taiwan, Zhejiang [Japan, Korea].

**5. *Lithospermum hancockianum*** Oliver, Hooker's Icon. Pl. 25: t. 2562. 1896.

石生紫草 shi sheng zi cao

*Lithodora hancockianum* (Oliver) Handel-Mazzetti;

*Lithospermum mairei* H. Léveillé.

Herbs perennial. Stems usually solitary, erect, 5–15 cm tall; lower stems with persistent leaf bases, forming a chaffy stem sheath. Leaves crowded on stems, sessile, broadly linear or linear-lanceolate, 4–15 cm × 3–9 mm, white short strigose, abaxially more densely strigose and gray-white. Inflorescences crowded, frequently branched; bracts same shape as leaves, 1–2 cm. Calyx ca. 1.1 cm; lobes linear, short strigose outside. Corolla purple-red; tube straight, 1–2.2 cm, pubescent outside; throat unappendaged but usually with 5 longitudinal pleats; limb ca. 1.3 mm wide; lobes broadly ovate, ca. 6 mm, veins evident. Stamens attached at apex of corolla tube; anthers ca. 1.6 mm, apex obtuse or acute. Style ca. 4 mm, slightly surpassing anthers, ca. 4 mm, apex slightly inflated; stigma capitate. Nutlets brown or white, triangular-ovoid, ca. 3 mm, glabrous, slightly pitted, shiny, adaxially longitudinally keeled. Fl. and fr. Mar–Aug.

• Limestone slopes. W Guizhou, Yunnan.

## 9. ARNEBIA Forsskål, Fl. Aegypt.-Arab. 62. 1775.

软紫草属 ruan zi cao shu

*Ulugbekia* Zakyrov.

Plants annual or perennial, bristly or pubescent. Roots frequently containing purple dye. Stems erect or prostrate. Leaves alternate. Cymes bracteate. Flowers often heterostylous. Calyx 5-parted to base, slightly enlarged, base sometimes hardened. Corolla funnelform, usually with hairs outside; tube straight or slightly curved; throat unappendaged; limb usually shorter than tube; lobes spreading. Ovary 4-lobed. Style 2- or 4-branched, each branch terminated with 1 stigma. Gynobase flat. Long-styled flowers with included stamens inserted at middle of corolla tube; style long, slightly exerted. Short-styled flowers with stamens inserted at throat; style shorter, reaching to middle of corolla tube. Nutlets oblique-ovate, tuberculate, adaxially flat or slightly concave; attachment scar at base.

About 25 species: N Africa, Europe, C and SW Asia, Himalaya; six species in China.

1a. Corolla blue-purple to purple-red.

2a. Plants densely gray-white hirsute; leaves small, less than 2.5 cm ..... 5. *A. fimbriata*

2b. Plants spreading white or pale yellow hirsute; leaves more than 5 cm ..... 6. *A. euchroma*

1b. Corolla yellow, rarely white.

3a. Herbs annual; stamens spirally inserted at apex of corolla tube ..... 1. *A. decumbens*

3b. Herbs perennial; stamens inserted at same level in corolla tube.

4a. Leaf blade more than 1.5 cm wide ..... 2. *A. tschimganica*

4b. Leaf blade less than 1.2 cm wide.

5a. Stems densely pubescent; stem leaves narrowly ovate to linear-oblong, 1–2 cm; inflorescences widely spaced ..... 3. *A. szechenyi*

5b. Stems both spreading long hispid and short strigose; stem leaves spatulate-linear, 1.5–5.5 cm; inflorescences crowded ..... 4. *A. guttata*

**1. *Arnebia decumbens*** (Ventenat) Cosson & Kralik, Bull. Soc. Bot. France 4: 402. 1857.

硬萼软紫草 ying e ruan zi cao

*Lithospermum decumbens* Ventenat, Descr. Pl. Nouv. 37, t. 37. 1800; *L. cornutum* Ledebour.

Herbs annual. Roots containing a purple dye. Stems erect, branched from base, 10–30 cm tall, spreading long

hispid; branches alternate or subopposite. Stem leaves sessile, linear-oblong to linear-lanceolate, 2–6 cm × 2–16 mm, sparsely hispid, apex obtuse. Calyx lobes linear, ca. 7 mm, to 1.2 cm in fruit, long hispid, short strigose, base extended and hardened, subtending nutlet. Corolla yellow, tubular-campanulate, 1–1.4 cm, pubescent outside; tube straight or slightly curved; limb 3–6 mm wide; lobes broadly ovate, subequal. Stamens spirally inserted at apex of corolla tube; anthers oblong, ca. 1 mm. Style filiform, nearly reaching

throat, twice 2-cleft; stigma globose. Nutlets brown, triangular-ovoid, ca. 2 mm, densely tuberculate, adaxial center line prominent, abaxially convex, slightly wrinkled, apex nearly keeled. Fl. and fr. May-Jun.  $2n = 8, 22$ .

Mountain slopes, sand, wasteland. N Xinjiang [Afghanistan, Mongolia, Pakistan, Turkmenistan; N Africa, SW Asia, Europe].

**2. *Arnebia tschimganica*** (B. Fedtschenko) G. L. Chu, Acta Phytotax. Sin. 20: 326. 1982.

天山软紫草 tian shan ruan zi cao

*Lithospermum tschimganicum* B. Fedtschenko, Izv. Bot. Sada Petra Velikago V, 1: 42. 1906; *Macrotomia tschimganica* (B. Fedtschenko) Popov ex Zakirov; *Ulugbekia tschimganica* (B. Fedtschenko) Zakirov.

Herbs perennial. Roots without purple dye. Stems several, not branched, 15–30 cm tall, pubescent. Petiole of basal leaves 4–10 cm; leaf blade oblanceolate, 8–15 × 2–4 cm, pubescent, base attenuate, margin entire, apex acuminate; stem leaves sessile, elliptic to oblong-lanceolate, base clasping. Cymes not branched; bracts lanceolate, ca. as long as flowers. Flowers heterostylous. Pedicel very short. Calyx ca. 8 mm at anthesis; lobes lanceolate to subulate, 6–8 mm. Corolla yellow, funnellform, 1.5–2 cm; limb ca. 8 mm wide. Anthers ca. 1.5 mm, apex obtuse. Style 2-cleft, each branch with 1, 2-cleft stigma. Nutlets unknown. Fl. Apr-May.

• Meadows, slopes, thickets, river marshes; 1000–2000 m. W Xinjiang.

The stigma in *Arnebia tschimganica* was originally described as entire which, coupled with the pollen type, places the species in *Lithospermum*. On the basis of habit, long tubular corolla, and minutely 4-lobed stigma, the species was placed in different genera, including the monotypic *Ulugbekia*.

**3. *Arnebia szechenyi*** Kanitz, Pl. Exped. Szechenyi in As. Centr. Coll. 42., t. 5. 1891.

疏花软紫草 shu hua ruan zi cao

*Lithospermum szechenyi* (Kanitz) I. M. Johnston.

Herbs perennial. Roots slightly containing purple dye. Stems sparsely branched, 20–30 cm tall, densely gray-white pubescent. Leaves sessile, narrowly ovate to linear-oblong, 1–2 cm × 2–6 mm, short strigose and minutely hispid, hairs discoid at base, margin obtusely serrate, apex acute, bristly. Cymes 1.5–5 cm, several flowered; bracts same shape as leaves. Flowers heterostylous. Calyx ca. 1 cm; lobes linear, densely hirsute and hirtellous on both sides. Corolla white, yellowish when dry, tubular-campanulate, 1.5–2.2 cm, short pubescent outside; limb 5–7 mm wide, frequently purple spotted. Anthers oblong, ca. 1.6 mm. Style filiform, apex 2-lobed. Nutlets light yellow-brown, triangular-ovate, ca. 2.7 mm, tuberculate, short appressed pubescent. Fl. and fr. Jun-Sep.

• Sunny mountain slopes. NW Gansu, Nei Mongol, Ningxia, E and S Qinghai.

**4. *Arnebia guttata*** Bunge, Index Sem. Hort. Petrop. 7. 1840.

黄花软紫草 huang hua ruan zi cao

*Arnebia thomsonii* C. B. Clarke; *A. tibetana* Kurz; *Lithospermum guttatum* (Bunge) I. M. Johnston; *Macrotomia guttata* (Bunge) Farrer.

Herbs perennial or sometimes biennial. Roots containing purple dye. Stems usually 2–4, sometimes only 1, erect, much branched, 10–25 cm tall, densely spreading long hispid, short strigose. Leaves sessile, spatulate-linear to linear, 1.5–5.5 cm × 3–11 mm, densely hirsute, hairs discoid at base, apex obtuse. Inflorescences crowded; cymes 3–10 cm; bracts linear-lanceolate. Flowers heterostylous. Calyx lobes linear, 6–10 mm, to 1.5 cm in fruit, long hispid. Corolla yellow, tubular-campanulate, pubescent outside; limb 7–12 mm wide; lobes spreading, broadly ovate or semiorbicular, frequently purple spotted. Anthers oblong, ca. 1.8 mm. Style filiform, apex 2-lobed; stigma reniform. Nutlets light yellow-brown, triangular-ovate, 2.5–3 mm, tuberculate. Fl. and fr. Jun-Oct.

Gobi Desert, rocky slopes, gravelly marshes. W Gansu, N Hebei, Nei Mongol, Ningxia, Xinjiang, Xizang [Afghanistan, NW India, Kazakhstan, Kyrgyzstan, Mongolia, Pakistan, Russia, Tajikistan, Turkmenistan, Uzbekistan].

There are biennial and perennial groups within the species, the former predominantly in Russia and Mongolia, the latter in Xizang and Xinjiang (*Arnebia tibetana*). These groups, which lack the blackish purple spots on corolla lobes, probably represent distinct subspecies.

The roots are used medicinally.

**5. *Arnebia fimbriata*** Maximowicz, Bull. Acad. Imp. Sci. Saint-Petersbourg 27: 507. 1881.

灰毛软紫草 hui mao ruan zi cao

Herbs perennial, densely gray-white hirsute. Stems usually numerous, much branched, 10–18 cm tall. Leaves sessile, linear-oblong to linear-lanceolate, 0.8–2.5 cm × 2–4 mm. Cymes 1–3 cm; bracts linear. Flowers crowded, heterostylous. Calyx lobes subulate, ca. 1.1 cm, densely hirsute on both sides. Corolla pale blue-purple or pink, sometimes white, 1.5–2.2 cm, sparsely pubescent; tube straight or slightly curved; limb 5–13 mm wide; lobes broadly ovate, subequal, margin irregularly dentate. Anthers ca. 2 mm. Style filiform, apex 2-lobed. Nutlets triangular-ovate, ca. 2 mm, densely tuberculate, glabrous. Fl. and fr. Jun-Sep.

Gobi Desert, rocky slopes, gravelly places. W Gansu, Ningxia, Qinghai (Qaidam Basin) [Mongolia].

**6. *Arnebia euchroma*** (Royle) I. M. Johnston, Contr. Gray Herb. 73: 49. 1924.

软紫草 ruan zi cao

*Lithospermum euchromon* Royle, Ill. Bot. Himal. Mts. 1: 305. 1839; *Macrotomia euchroma* (Royle) Paulsen.

Herbs perennial. Roots stout, to 2 cm in diam., containing copious purple dye. Stems usually 1 or 2, erect, branched above, sheathed with remaining bases of leaves, 15–40 cm tall, spreading white or pale yellow hirsute. Leaves sessile, sparsely semiappressed hirsute. Basal leaves linear to

linear-lanceolate, 7–20 × 0.5–1.5 cm, base sheathlike, apex short acuminate; stem leaves lanceolate to linear-lanceolate, smaller without sheathlike base. Cymes terminal, 2–6 cm at anthesis, many flowered; bracts lanceolate. Flowers heterostylous. Calyx lobes linear, 1.2–1.6 cm, to 3 cm in fruit, densely pale yellow hirsute on both sides, apex subacute. Corolla dark purple, sometimes pale yellow and purple-red tinged, tubular-campanulate, glabrous or sparsely short pubescent outside; tube straight, 1–1.4 cm; limb 6–10 mm wide; lobes spreading, ovate. Anthers ca. 2.5 mm. Style apex

2-lobed; stigmas 2, obovate. Nutlets black-brown, broadly ovate, ca. 3.5 × 3 mm, scabrous reticulate lined, with few tubercles, adaxially almost flat, center line prominent, abaxially convex, apex subacute; attachment scar somewhat triangular. Fl. and fr. Jun-Aug.

Rocky slopes, gravelly marshes, meadows. Xinjiang, W Xizang [Afghanistan, NW India, Kazakhstan, Kyrgyzstan, Nepal, Pakistan, Russia, Tajikistan, Turkmenistan, Uzbekistan; SW Asia].

The roots are used medicinally.

## 10. STENOSOLENIUM Turczaninow, Bull. Soc. Imp. Naturalistes Moscou 13: 253. 1840.

紫筒草属 *zi tong cao shu*

Herbs annual or biennial, hirtellous. Roots with little purple-red dye. Leaves alternate. Cymes scorpioid. Flowers short pedicellate. Calyx 5-parted nearly to base; lobes linear, slightly enlarged in fruit or not, without hardened base, apex acute. Corolla light violet, purple, or white, ca. 2 cm; tube narrow, long; throat unappendaged, with a narrow protective ring of hairs at base of tube; limb campanulate, 5-parted; lobes broadly ovate, apex rounded. Filaments extremely short, spirally attached slightly above middle of corolla tube; anthers broadly elliptic, apex obtuse. Ovary 4-divided. Style filiform, included, apex shortly 2-cleft; stigma 1 on each branch, globose. Gynobase nearly flat. Nutlets gray-brown, oblique ovoid, vertical, ca. 2 mm, densely tuberculate, apex acute; short stipe at base.

One species: China, Kazakhstan, Mongolia, Russia.

**1. *Stenosolenium saxatile*** (Pallas) Turczaninow, Bull. Soc. Imp. Naturalistes Moscou 13: 253. 1840.

紫筒草 *zi tong cao*

*Anchusa saxatile* Pallas, Reise Russ. Reich. 3: 718. 1776; *Arnebia saxatile* (Turczaninow) Benth. & J. D. Hooker; *Onosma saxatile* (Pallas) Lehmann.

Roots purplish brown, thin. Stems erect or ascending, not branched or less branched above, 10–25 cm tall, densely spreading hirsute, short strigose. Basal and lower stem leaves spatulate-linear or oblanceolate-linear. Upper stem leaves

sessile, lanceolate-linear, 1.5–4.5 cm × 3–8 mm, densely hispid, apex obtuse or subobtuse. Cymes terminal, gradually elongate, densely hispid; bracts leaflike. Calyx ca. 7 mm, densely hirsute; lobes erect in fruit, subulate, base subtending fruit. Corolla 1–1.4 cm, sparsely strigose outside; tube thin, distinctly longer than limb, usually subarcuate; limb 5–7 mm wide; lobes spreading. Stipe of nutlets ca. 0.5 mm, attachment scar at base of stipe. Fl. May-Sep.

Meadows, roadsides, cultivated ground. NW Gansu, Hebei, Heilongjiang, Jilin, Liaoning, Nei Mongol, Ningxia, Qinghai, Shaanxi, Shandong, N Shanxi [Kazakhstan, Mongolia, Russia].

## 11. MAHARANGA A. de Candolle, Prodr. 10: 71. 1846.

胀萼紫草属 *zhang e zi cao shu*

Herbs perennial or biennial, perhaps sometimes annual. Cymes terminal on main stem and sometimes on leafy branches, not clearly scorpioid, forming ± glomerate clusters wider than long, becoming ± corymbose or loosely racemose in fruit, bracteate. Calyx parted to middle or slightly below; lobes 5, narrowly triangular or cuneate. Corolla blue, purplish, yellow, or white, ovoid-ellipsoid or obovoid, contracted at both ends, abruptly expanding from a short tube into a relatively large inflated throat, with inflated ribs below lobes and deep furrows between them; throat unappendaged; lobes loosely recurved above middle; nectary ringlike, ± minutely villous. Anthers coherent at base, affixed below middle; filaments affixed at base of throat. Style included or slightly exerted. Gynobase broadly pyramidal. Nutlets slightly incurved, ± ovoid, ca. as long as wide, adaxially with a coarse prominent keel; attachment scar basal.

About nine species: Bhutan, India, Nepal, Thailand; five species in China.

1a. Corolla 1.4–1.6 cm.

2a. Stem leaves crowded, rounded at base; corolla tube with inflated, pubescent folds ..... 1. *M. microstoma*

2b. Stem leaves widely spaced, attenuate at base; corolla tube glabrous inside except for pilose glands ..... 2. *M. lycopsioides*

1b. Corolla 0.9–1.1 cm.

3a. Corolla dirty red, urceolate ..... 3. *M. emodi*

3b. Corolla yellow or purple, tubular.

4a. Stem leaves oblong or oblong-lanceolate, 2–5 × 0.6–1.3 cm; filaments 1.5–2.5 mm ..... 4. *M. bicolor*

4b. Stem leaves broadly lanceolate, 3–7 × 1.5–2.5 cm; filaments 4–5 mm ..... 5. *M. dumetorum*

**1. *Maharanga microstoma*** (I. M. Johnston) I. M. Johnston, J. Arnold Arbor. 35: 81. 1954.

镇康胀萼紫草 zhen kang zhang e zi cao

*Onosma microstoma* I. M. Johnston, J. Arnold Arbor. 32: 360. 1951.

Herbs perennial, 30–50 cm tall, with stout roots. Stems several, cespitose, erect or ascending, unbranched, densely yellow hispid, short strigose. Basal leaves linear-lanceolate, 4–10 cm × 3–7 cm, abaxially densely strigose and densely hispid on midvein and margin, adaxially hispid and strigose, gradually withered at anthesis; stem leaves crowded, sessile, lanceolate, 3–6 × 1–1.5 cm, base rounded, apex acuminate. Inflorescences terminal, subcapitate, 3–4 cm wide at anthesis, many flowered. Pedicel slender, 2–8 mm, densely yellow hispid. Calyx cupular, 6–8 mm, yellow hispid and short strigose outside, densely white villous inside, parted to middle or slightly below; lobes narrowly triangular, ca. 5 mm. Corolla blue-purple, 1.1–1.6 cm, base 1.5–2 mm wide, gradually expanded upward, widest above middle, 7–9 mm wide; throat constricted, 3–4 mm wide, densely short strigose, 5-sulcate below middle; folds inflated, 4–6 mm, pubescent; nectary 1–1.5 mm, pubescent. Filaments subulate, 4–4.5 mm, pubescent at base, inserted 5–6 mm above base of corolla tube; base of anthers united, 5–5.5 mm, included, sterile apex ca. 1 mm. Style 1.6–1.7 cm, glabrous, exserted. Fl. Aug.

• Open rocky slopes; ca. 3000 m. SW Yunnan.

**2. *Maharanga lycopsioides*** (C. E. C. Fischer) I. M. Johnston, J. Arnold Arbor. 35: 81. 1954.

宽 胀萼紫草 kuan zhang e zi cao

*Onosma lycopsioides* C. E. C. Fischer, Bull. Misc. Inform. Kew 1940: 39. 1940.

Herbs perennial, ca. 30 cm tall, with stout straight roots. Stems several, cespitose, erect or ascending, densely hispid, short strigose. Basal leaves petiolate, oblanceolate, 10–15 × 1–1.5 cm, densely hispid and short strigose, base attenuate, apex acuminate; stem leaves widely spaced, lanceolate or broadly lanceolate, 4–9 × 1–2 cm, sparsely white hispid, base attenuate. Inflorescences terminal, in panicle, 2–4 cm wide at anthesis, 9–11 cm in fruit; bracts ovate-lanceolate, 7–10 × 2–3 mm. Pedicel 3–6 mm, elongated in fruit, densely hispid and strigose. Calyx 6–7 mm, parted to 1/3 from base; lobes narrowly triangular or ovate-lanceolate, 4–5 mm, hispid and short strigose outside, densely antrorse villous inside. Corolla blue or pale blue-purple, tubular, 1.4–1.5 cm, ca. 5 mm wide at middle; throat constricted, 3–4 mm wide, densely pubescent outside, glabrous inside except for pilose glands; nectary ca. 1 mm, glabrous or sparsely pubescent; lobes triangular, ca. 1 mm. Filaments ca. 5 mm, inserted ca. 5 mm above base of corolla tube; base of anthers united, ca. 5 mm, included, sterile apex ca. 1 mm. Style ca. 1.5 cm, glabrous. Nutlets ovoid, ca. 2 mm, not shiny. Fl. and fr. Apr-May.

Moist thickets, open hillsides; 1600–3000 m. Yunnan (Jinghong Xian) [India, Thailand].

**3. *Maharanga emodi*** (Wallich) A. de Candolle, Prodr. 10: 71. 1846.

污花胀萼紫草 wu hua zhang e zi cao

*Onosma emodi* Wallich in Roxburgh, Fl. Ind. 2: 11. 1824.

Herbs perennial, 30–40 cm tall, with straight roots. Stems several, cespitose, prostrate or ascending, not branched, hispid, short strigose. Leaves sessile, linear-lanceolate or oblanceolate, 5–10 × 0.6–1.7 cm, hispid and short strigose, base rounded or cuneate, apex acuminate. Inflorescences terminal, subcapitate, 2–4 cm wide at anthesis; bracts lanceolate, 5–10 × 1–2 mm, densely hispid and pubescent. Pedicel slender, 4–10 mm, to 1.5 cm in fruit, densely hispid and strigose. Calyx 7–9 mm, parted to 1/3 from base; lobes lanceolate-triangular, densely hispid and short strigose outside, densely villous inside. Corolla dirty red, urceolate, 0.9–1.1 cm, base 2–3 mm wide, widest at middle, 6.5–8 mm wide; throat 3–4 mm wide; nectary ringlike, ca. 1 mm, membranous, pubescent; lobes of limb reflexed, triangular, ca. 1 mm, densely strigose outside, 5-sulcate below middle, folds semielliptic, ca. 2 mm, pubescent. Filaments ca. 1.5 cm, inserted 2–2.5 mm above base of corolla tube; anthers united at base, 4.5–5 mm, included. Style ca. 1 cm, glabrous. Nutlets 2–2.5 mm, tuberculate, wrinkled. Fl. Jun-Jul.

Moist places by streams; 1600–3000 m. Xizang [Bhutan, NE India, Nepal].

*Maharanga microstoma* resembles *M. emodi* but differs by having a blue-purple, oblong-obovoid corolla.

**4. *Maharanga bicolor*** (Wallich ex G. Don) A. de Candolle, Prodr. 10: 71. 1846.

二色胀萼紫草 er se zhang e zi cao

*Onosma bicolor* Wallich ex G. Don, Gen. Hist. 4: 317. 1837.

Herbs perennial or biennial, green, 20–35 cm tall, hispid, short strigose. Stems single or several, cespitose, erect or ascending, not branched, slender. Basal leaves linear-lanceolate or oblanceolate, 5–12 × 0.5–1.5 cm, hispid and short strigose, base attenuate, apex obtuse or acute; stem leaves sessile, oblong or oblong-lanceolate, 2–5 × 0.6–1.3 cm. Inflorescences terminal, subcapitate, 1.5–2.5 cm wide at anthesis; bracts lanceolate, 3–5 mm, densely hispid, short strigose. Pedicel 2–4 mm, to 8 mm in fruit, densely hispid and strigose. Calyx 5–6 mm, densely hispid and short strigose outside, densely villous inside; lobes triangular-lanceolate. Corolla blue apically, orange basally, tubular, 8–10 mm; throat 3–4 mm wide; nectary ringlike, 1.5–2 mm, membranous, sparsely pubescent; lobes reflexed, rarely straight, triangular, ca. 0.5 mm, with sparsely villous folds. Filaments 1.5–2.5 mm, inserted 4–5 mm above base of corolla tube; anthers united at base, 3.5–4 mm, included. Nutlets brown, ca. 3 mm, densely tuberculate and papillate. Fl. and fr. Jul.  $2n = 14$ .

Hillside meadows, valleys, forest margins; 2300–3700 m. SW Xizang (Gyirong Xian) [Bhutan, NE India, Nepal].

**5. *Maharanga dumetorum*** (I. M. Johnston) I. M. Johnston, J. Arnold Arbor. 35: 81. 1954.

丛林胀萼紫草 cong lin zhang e zi cao

*Onosma dumetorum* I. M. Johnston, J. Arnold Arbor. 32: 361. 1951.

Herbs biennial, gray, 30–60 cm tall, densely white hispid, strigose. Stems single or several cespitose, erect to ascending, not branched. Basal leaves oblanceolate, 4–6 cm × 3–5 mm, densely hispid and short strigose, base attenuate, apex obtuse or acute; stem leaves broadly lanceolate, 3–7 × 1.5–2.5 cm. Inflorescences terminal, branched, 2.5–4 cm wide at anthesis; bracts lanceolate, 5–10 × 1–4 mm, hispid, strigose. Pedicel 2–5 mm, densely hispid, strigose. Flowers crowded. Calyx 6–7 mm, parted to slightly below middle,

hispid and short strigose outside, densely villous inside; lobes triangular-lanceolate. Corolla yellow, tubular, 1–1.2 cm, 3–4 mm wide at middle, densely short strigose outside; nectary ringlike, ca. 1.5 mm, membranous, irregularly lobed, base white pubescent; lobes usually recurved, triangular, ca. 0.5 mm, margin revolute. Filaments decurrent, 4–5 mm, decurrent part and nearby part of corolla tube pubescent, inserted 2.5–3 mm above base of corolla tube; anthers 3.5–4 mm, included, united at base, sterile apex ca. 1 mm. Nutlets tuberculate, papillate. Fl. Jul.

- Thickets, forest margins; ca. 2400 m. SW Yunnan.

## 12. ONOSMA Linnaeus, Sp. Pl. ed. 2, 1: 196. 1762.

滇紫草属 dian zi cao shu

Herbs biennial or perennial, rarely subshrubs, scabrous. Leaves petiolate or sessile, margin entire. Cymes scorpioid, solitary at stem apex or terminating stems and branches and forming a panicle, usually elongated in fruit, bracteate. Flowers actinomorphic, pedicellate or sessile. Calyx parted to or nearly to base; lobes 5, linear or linear-lanceolate, equal, usually enlarged after anthesis. Corolla blue, yellow, rarely white or red, tubular-campanulate or retrorse-conical, usually gradually expanded from base upward, rarely abruptly expanded from middle; throat unappendaged; nectary ringlike or irregularly lobed, pubescent or glabrous; lobes vertical or recurved, margin dentate. Anthers laterally coherent into a tube or sagittate at base, usually pellucid, emarginate, apex sterile. Style included or slightly exerted; stigma capitate. Gynobase flat. Nutlets 4, erect, ovate-triangular, length and width subequal, adaxially usually ribbed, abaxially slightly convex; attachment scar basal.

About 145 species: centered in Asia, 29 species in China.

- 1a. Anthers coherent only at base.
  - 2a. Corolla 2–2.5 cm; filaments inserted at or above middle of corolla tube.
    - 3a. Corolla blue, purple, or light purple-red ..... 1. *O. hookeri*
    - 3b. Corolla yellow or light yellow.
      - 4a. Herbs, mostly biennial; stems branched; leaves not convolute; anther appendages exerted; nutlets 4–5 mm ..... 6. *O. setosa*
      - 4b. Subshrubs or perennial herbs; stems mostly not branched; leaves convolute; anthers included; nutlets 2.5–3 mm ..... 7. *O. simplicissimum*
  - 2b. Corolla 0.7–1.6 cm; filaments inserted below middle of corolla tube.
    - 5a. Corolla red, 7–9 mm, ca. as long as calyx lobes; filaments inserted ca. 2.5 mm above base of corolla tube ..... 2. *O. cingulatum*
    - 5b. Corolla blue or red, 10–16 mm, longer than calyx lobes; filaments inserted 4–5.5 mm above base of corolla tube.
      - 6a. Stems several, branched at base; inflorescences terminal and axillary, capitate; corolla 1–1.2 cm ..... 4. *O. glomeratum*
      - 6b. Stem single, unbranched, or branched at middle; inflorescences terminal, elongated; corolla 1.4–1.6 cm.
        - 7a. Plants gray; basal leaves oblanceolate, apex acuminate; inflorescences sometimes dichotomously branched; nutlets gray ..... 3. *O. mertensioides*
        - 7b. Plants green; basal leaves linear-lanceolate, apex obtuse; inflorescences unbranched; nutlets yellow-white ..... 5. *O. zayuense*
- 1b. Anthers coherent into a tube.
  - 8a. Anthers included, or only sterile apex exerted from corolla.
    - 9a. Filaments and style pubescent.
      - 10a. Stems single, not branched; upper stem leaves hastate and usually clasping at base ..... 11. *O. paniculatum*
      - 10b. Stems several, cespitose, branched from base; upper stem leaves cuneate or rounded at base ..... 12. *O. lijiangense*
    - 9b. Filaments and style glabrous.
      - 11a. Corolla 2–2.7 cm.
        - 12a. Corolla club-shaped, lobes apiculate; bracts longer than calyx ..... 9. *O. apiculatum*
        - 12b. Corolla not club-shaped, lobes not apiculate; bracts not longer than calyx.

- 13a. Leaves green, only 4–5 mm wide ..... 8. *O. irritans*  
 13b. Leaves gray-white, wider than 5 mm ..... 10. *O. gmelinii*  
 11b. Corolla 1–1.3 cm.  
 14a. Filaments not decurrent, base expanded, triangular ..... 16. *O. maaiakensense*  
 14b. Filaments decurrent.  
 15a. Filaments inserted near middle of corolla tube, decurrent part linear, mealy, minutely pubescent ..... 15. *O. waltonii*  
 15b. Filaments inserted at lower part of corolla tube, decurrent part oblong, not pubescent.  
 16a. Leaf blade gray-white abaxially, densely strigose, with only midvein evident; corolla lobe short strigose inside on midveins ..... 14. *O. confertum*  
 16b. Leaf blade gray abaxially, densely pubescent and strigose, 3-veined; corolla lobes glabrous or nearly so ..... 13. *O. wardii*  
 8b. Anthers half to completely exerted from corolla.  
 17a. Filament bases and adjacent corolla tube pilose.  
 18a. Filament insertion with sparse hairs, not forming a ring ..... 17. *O. liui*  
 18b. Filament insertion with dense hairs, forming a ring.  
 19a. Stems herbaceous, pallid; stem leaves lanceolate, 3–8 × 1–1.5 cm, base rounded, apex acuminate, 3-veined, lateral veins conspicuous; corolla 10-ranked, minutely hispid inside ..... 19. *O. decastichum*  
 19b. Stems suffruticose, gray-green; stem leaves oblanceolate, 1–1.5 × 0.2–0.5 cm, base attenuate or sessile, apex obtuse, only midvein evident.  
 20a. Base of filaments and corolla interior glabrous; calyx ca. 6 mm; corolla 11–11.5 mm ..... 21. *O. farreri*  
 20b. Base of filaments and adjacent parts of corolla villous; calyx 7–9 mm; corolla 8–9.5 mm ..... 20. *O. sinicum*  
 17b. Filament base and adjacent corolla tube glabrous.  
 21a. Stems single, stout, base 0.8–1.4 cm wide; plants biennial.  
 22a. Anthers half exerted; corolla 11–14 mm, throat 5–8.5 mm wide, tube glabrous inside ..... 18. *O. fistulosum*  
 22b. Anthers completely exerted; corolla 7–8 mm, throat 3–3.5 mm wide, tube sparsely pubescent inside ..... 29. *O. exsertum*  
 21b. Stems usually several, more slender; plants perennial or, if biennial, caespitose.  
 23a. Anthers and buds curved at apex ..... 27. *O. multiramum*  
 23b. Anthers and buds straight.  
 24a. Filament bases and adjacent corolla tube papillate, glandular.  
 25a. Leaf blade lanceolate to oblong, only midvein evident; inflorescences terminal and axillary, branches slender; calyx lobes linear, 5–7 × < 1 mm; nutlets yellow-white, 2–3 mm, tuberculate, wrinkled ..... 25. *O. adenopus*  
 25b. Leaf blade ovate-lanceolate or linear-lanceolate, 3-veined; inflorescences terminal, branches stout; calyx lobes lanceolate, 7–9 × 1–2 mm; nutlets gray-brown, ca. 3 mm, papillate, tuberculate ..... 26. *O. nangqenense*  
 24b. Filament base and adjacent corolla tube not papillate or glandular, rarely papillate on decurrent part of filament.  
 26a. Leaf blade gray-white abaxially, hispid, densely appressed pubescent.  
 27a. Leaves noticeably 3-veined; style glabrous ..... 24. *O. yajiangense*  
 27b. Leaves with only midvein evident; style pubescent below middle ..... 23. *O. album*  
 26b. Leaf blade green or light green abaxially, sparsely short appressed pubescent or pilose, sparsely hispid.  
 28a. Corolla obscurely pubescent outside, throat 4–9 mm wide; filaments decurrent, 6.5–7 mm ..... 28. *O. waddellii*  
 28b. Corolla short strigose outside, throat 4–5 mm wide; filaments not decurrent ..... 22. *O. luquanense*

**1. *Onosma hookeri*** C. B. Clarke in J. D. Hooker, Fl. Brit. India 4: 178. 1883.

细花滇紫草 xi hua dian zi cao

Herbs perennial, 20–30 cm tall, hispid, strigose, hairs discoid at base. Stems single to several, caespitose, not branched. Basal leaves oblanceolate, 5–15 × 0.5–1.5 cm, abaxially densely short strigose, adaxially hispid; stem leaves

sessile, lanceolate to narrowly lanceolate, 3–8 cm × 4–10 mm, base obtuse to rounded, apex acute. Inflorescences usually solitary, terminal, 3–5 cm wide at anthesis, many flowered; bracts narrowly lanceolate. Pedicel 2–4 mm, densely hispid. Flowers crowded. Calyx lobes subulate, 1–1.5 cm, hispid, strigose. Corolla blue, purple, or light purple-red, tubular-campanulate, 1.7–3.3 cm; throat 7–8 mm wide, base 2–3 mm wide, strigose above middle and pubescent outside, glabrous

inside; lobes broadly triangular, ca. 1.5 × 3 mm, margin revolute. Filaments linear, 5–6 mm, inserted at middle to ca. 2/3 from base of corolla tube; anthers united at base, 7–8 mm, sterile apex ca. 1 mm. Style exerted, 2.2–2.8 cm, glabrous. Nutlets unknown. Fl. Jun-Jul.

Hillsides, meadows, thickets; 3000–4700 m. Xizang [Bhutan, India, Nepal].

- 1a. Corolla 1.7–2.2 cm ..... 1a. var. *hookeri*  
1b. Corolla 3–3.3 cm.  
2a. Filaments inserted ca. 2/3 from base  
of corolla ..... 1b. var. *longiflorum*  
2b. Filaments inserted at middle of corolla  
tube or somewhat above ..... 1c. var. *hirsutum*

### 1a. *Onosma hookeri* var. *hookeri*

细花滇紫草 (原变种) xi hua dian zi cao (yuan bian zhong)

*Onosma hookeri* subsp. *wardii* Stapf; *O. hookeri* var. *intermedium* I. M. Johnston.

Corolla 1.7–2.2 cm. Style glabrous. Fl. Jun-Jul.

Hillsides, valley meadows; 3100–4100 m. Xizang [Bhutan, NE India].

### 1b. *Onosma hookeri* var. *longiflorum* (Duthie) Duthie ex Stapf, Bot. Mag. 155: t. 9254. 1931.

长花细花滇紫草 chang hua xi hua dian zi cao

*Onosma longiflorum* Duthie, Bull. Misc. Inform. Kew 1912: 40. 1912.

Corolla usually 3–3.3 cm. Filaments inserted ca. 2/3 from base of corolla tube. Style glabrous. Fl. and fr. Aug.

Gravelly slopes, meadows, thickets; 3000–4700 m. Xizang [Nepal].

### 1c. *Onosma hookeri* var. *hirsutum* Y. L. Liu, Acta Phytotax. Sin. 18: 66. 1980.

毛柱细花滇紫草 mao zhu xi hua dian zi cao

Corolla 3.2–3.3 cm. Filaments inserted at middle of corolla tube or somewhat above. Style minutely hispid. Fl. Jul.

- Rocky and sandy hillsides; ca. 3800 m. Xizang (Lhasa Shi).

### 2. *Onosma cingulatum* W. W. Smith & Jeffrey, Notes Roy. Bot. Gard. Edinburgh 9: 112. 1916.

昭通滇紫草 zhao tong dian zi cao

*Onosma tsiangii* I. M. Johnston.

Herbs annual, yellow-green, 50–70(–150) cm tall, densely yellow hispid, reflexed white pubescent. Stems single, not branched. Basal leaves oblanceolate, 5–10 × 0.5–1.2 cm, abaxially densely strigose and sparsely hispid, adaxially densely hispid, hairs discoid at base, base attenuate

into petiole, apex obtuse; stem leaves lanceolate or ovate-lanceolate, 4–7 × 1–2 cm, base rounded, apex acute. Inflorescences terminal and axillary, forming a large panicle; bracts linear-lanceolate to lanceolate, 0.5–2 cm × 2–7 mm, densely yellow hirsute and sparsely white strigose. Pedicel pendulous or recurved, slender, 1–1.5 cm, densely hispid. Flowers widely spaced. Calyx 6–8 mm, to 1.2–1.4 cm in fruit, parted nearly to base; lobes linear-lanceolate. Corolla red, tubular-campanulate, 7–9 mm, ca. 1.5 mm wide at base, gradually expanded upward, densely short strigose above middle outside, glabrous inside except for nectaries; throat 4–5.5 mm wide; nectary ringlike, ca. 0.5 mm, villous; lobes broadly triangular, ca. 1 × 2–2.5 mm, margin revolute. Filaments subulate, 2.5–3.5 mm, inserted ca. 2.5 mm above base in corolla tube; anthers united at base, ca. 4 mm, included. Nutlets black, ca. 2.5 mm, shiny. Fl. Jul.

- Rocky slopes, thickets, meadows; 2000–2800 m. Yunnan.

*Onosma tsiangii* differs from typical *O. cingulatum* by having fewer patent bristles on the leaf blade, calyx not yellow when dry, basal tubercles on stem bristles, and shorter hairs on leaf blade abaxially. These characteristics indicate that the taxon should be treated either as a variety or only as a later state of development. Sparse bristles and basal tubercles are characteristic of a later stage of development throughout the Boraginoideae.

### 3. *Onosma mertensioides* I. M. Johnston, J. Arnold Arbor. 32: 353. 1951.

川西滇紫草 chuan xi dian zi cao

Herbs perennial, gray, 15–30 cm tall, hispid, reflexed-pilose. Stems single, erect, not branched. Basal leaves oblanceolate, 5–11 × 0.5–1.5 cm, abaxially densely appressed pubescent, adaxially appressed hispid, hairs discoid at base, base cuneate, apex acuminate; stem leaves oblong-lanceolate, 3–6 cm × 5–7 mm, base rounded or broadly cuneate, apex obtuse. Inflorescences terminal, solitary or dichotomously branched, racemose, 10–12 cm; bracts ovate-lanceolate, 3–7 mm, hispid, appressed pubescent. Pedicel 5–6 mm, elongated in fruit, stout, densely yellow hispid, white appressed pubescent. Calyx 7–8 mm, elongated in fruit, yellow hispid, parted nearly to base; lobes linear-lanceolate. Corolla blue-purple, changing to red late in season, tubular-campanulate, 1.2–1.6 cm, base ca. 2 mm wide, gradually expanded upward; throat 5–6 mm wide, densely short appressed pubescent outside, obscurely pubescent inside along veins; nectary ringlike, ca. 0.5 mm, lobed, pubescent; lobes triangular, ca. 1.5 mm, margin revolute. Filaments subulate, 4–5 mm, inserted ca. 5 mm above base of corolla tube; anthers united at base, 6–7 mm, included; apex sterile, ca. 1 mm. Nutlets gray, ca. 3 mm, shiny, sparsely papillate. Fl. and fr. Jul.

- Meadows; 3900–4000 m. SW and W Sichuan.

### 4. *Onosma glomeratum* Y. L. Liu, Acta Phytotax. Sin. 18: 66. 1980.

团花滇紫草 tuan hua dian zi cao

Herbs, gray-white, 20–30 cm tall, densely hispid. Stems several, cespitose, erect or ascending, branched from base. Leaf blade lanceolate or oblanceolate, 2–5 cm × 3–5 mm,

base attenuate or rounded, apex obtuse or acute. Inflorescences terminal and axillary, subcapitate, 2–4 cm wide at anthesis, many flowered. Pedicel slender, very short. Flowers crowded. Calyx 7–8 mm; lobes linear-lanceolate, densely hispid outside, glabrous inside. Corolla red, tubular, 1–1.2 cm; throat 2–2.5 mm wide, widest at middle, 3–4 mm wide, glabrescent; nectary ca. 0.5 mm, glabrescent; lobes erect, triangular, ca. 1 × 1 mm, margin revolute. Filaments 2–2.5 mm, inserted 5–5.5 mm above base in corolla tube, decurrent base linear, ca. 3 mm; anthers united at base, ca. 5 mm, included; apex sterile, 0.5–1 mm. Style 1–1.2 cm, glabrous. Nutlets unknown. Fl. Aug.

- Sandy slopes; ca. 3700 m. Xizang (Leiwuqi Xian).

*Onosma glomeratum* resembles *O. limitaneum* I. M. Johnston from Afghanistan, NW India, Iran, and Pakistan, except the calyx lobes are glabrous inside, and the filament bases are decurrent and inserted at the same level. In *O. limitaneum* the calyx lobes are densely villous, and the filament bases are not decurrent and at different levels.

**5. *Onosma zayuense*** Y. L. Liu, Acta Phytotax. Sin. 18: 65. 1980.

察隅滇紫草 cha yu dian zi cao

Herbs perennial, green, ca. 35 cm tall, spreading hispid, pubescent. Stems slender, branched from middle. Basal leaves linear-lanceolate, 10–15 × 1–2 cm, abaxially densely pilose and sparsely appressed pubescent, adaxially hispid and short appressed pubescent, hairs discoid at base, base attenuate, apex obtuse; stem leaves sessile, oblong or lanceolate, 2.5–3 cm × 5–9 mm. Inflorescences terminal, not branched, racemose after anthesis, 5–7 cm; bracts linear-lanceolate, ca. 12 × 2 mm. Pedicel slender, 1–1.5 cm, slightly elongated in fruit, spreading yellow hispid. Calyx parted to base; lobes linear-lanceolate, 1–1.2 cm × ca. 1 mm, hirsute. Corolla tubular-campanulate, 1.4–1.5 cm, base 1.5–2 mm wide; throat ca. 5 mm wide, pubescent outside above middle, glabrous inside except for nectaries; nectary pubescent; lobes triangular, ca. 1.5 × 1 mm, margin revolute. Filaments ca. 4 mm, inserted 4–5 mm above base in corolla tube, decurrent part thickened, linear, ca. 3 mm; anthers united at base, ca. 7.5 mm, slightly exerted; apex sterile, ca. 2.5 mm. Style 1.5–1.7 cm, glabrous. Nutlets light yellow-white, ca. 3.5 mm, shiny. Fl. and fr. Aug.

- River banks; ca. 3300 m. SE Xizang.

**6. *Onosma setosa*** Ledebour, Beitr. Naturk. 70. 1820.

刚毛滇紫草 gang mao dian zi cao

Herbs perennial, 20–40 cm tall. Stems single or several and cespitose, erect or ascending. Basal leaves oblanceolate, 10–25 cm × 5–10 mm, base attenuate, apex obtuse; stem leaves sessile, linear or lanceolate, 2.5–6.5 cm × 5–7 mm. Inflorescences terminal, 3–4 cm wide at anthesis, to 15 cm in fruit, racemose, many flowered; bracts lanceolate, 1–2 cm × 3–6 mm. Pedicel short, ca. 5 mm, elongated in fruit, spreading yellow hispid, short strigose. Flowers crowded. Calyx 1–1.5 cm, to 3 cm in fruit, densely hirsute, parted nearly to base; lobes linear-lanceolate. Corolla yellow; tubular-campanulate, base 2–2.5 mm wide, gradually

expanded upward; throat 5–7 mm wide, glabrous on both sides; nectary ringlike, ca. 0.5 mm, glabrous; lobes broadly triangular, 1–2 mm, recurved at apex. Filaments 3–5 mm; anthers united at base, 8–10 mm, included, sterile apex 1–1.5 mm. Style 2.5–2.8 cm, exerted from corolla. Nutlets yellow-brown, ca. 5 mm, wrinkled. Fl. and fr. Jun.  $2n = 12$ .

Steppes, stony slopes. Xinjiang [Kazakhstan, Mongolia, Russia].

- 1a. Plants whitish gray hirsute; corolla 2–2.2(–2.5) cm ..... 6a. subsp. *setosa*
- 1b. Plants yellow-green hirsute; corolla 1.5–1.8(–2) cm ..... 6b. subsp. *transrhymense*

**6a. *Onosma setosa* subsp. *setosa***

刚毛滇紫草 (原变种) gang mao dian zi cao (yuan bian zhong)

Plants whitish gray hirsute above. Corolla 2–2.2(–2.5) cm.

Xinjiang [Kazakhstan, Russia].

**6b. *Onosma setosa* subsp. *transrhymense*** (Klokov ex Popov) Kamelin, Novon 3: 263. 1993.

黄刚毛滇紫草 huang gang mao dian zi cao

*Onosma transrhymense* Klokov ex Popov, Spisok Rast. Gerb. Fl. SSSR 12: 219. 1953.

Plants yellow-green hirsute above. Corolla 1.5–1.8(–2) cm.

Steppes, stony slopes. Xinjiang [Kazakhstan, Mongolia, Russia].

**7. *Onosma simplicissimum*** Linnaeus, Sp. Pl. ed. 2, 1: 196. 1762.

单茎滇紫草 dan jing dian zi cao

Subshrubs or perennial herbs, with short branched caudex, densely silky appressed pilose. Stems single or several, simple, erect to ascending, 10–20 cm. Leaves linear, 3–5 cm × 2–4 mm, margin usually slightly rolled, apex acute. Inflorescences small, furcate, compressed at anthesis, elongated in fruit. Pedicel short. Calyx 6–8 mm, to 1.3 cm in fruit. Corolla light yellow, 1.8–2 cm. Nectary glabrous or sparsely short pubescent. Anthers included. Nutlets dark gray, 2.5–3 mm, smooth, with well developed shoulders. Fl. May–Jun, fr. Jul.  $2n = 14$ .

Stony slopes, on rocks, in mountain-steppe belt. NW Xinjiang (Altay Shan) [Kazakhstan, Russia; Europe].

**8. *Onosma irritans*** Popov ex Pavlov, Trudy Sredne-Aziatsk. Gosud. Univ., ser. 8b, Bot. 19: 29. 1935.

过敏滇紫草 guo min dian zi cao

Herbs perennial, 20–40 cm tall. Stems simple, stout, spreading thin long white bristly. Basal leaves petiolate, green; stem leaves sessile, spreading long thin bristly, glabrous between bristles; middle stem leaves broadly linear to linear-lanceolate, 4–7 cm × 4–5 mm, apex acute. Cymes

terminal, scorpioid, not elongated in fruit; bracts lanceolate, ca. as long as calyx. Pedicel very short. Calyx ca. 2 cm at anthesis, ca. 2.5 cm in fruit; lobes slightly diverging, linear, very long spreading, white bristly, apex acute. Corolla yellow, 2.5–2.7 cm, only slightly expanded upward, with short triangular teeth. Anthers coherent for their full length, slightly longer than filaments; apex sterile, exserted. Nutlets dark gray, ca. 5 mm, rugose-pitted, tuberculate, beaked.

Rocks, gravel. Xinjiang (Yining Xian) [Kazakhstan, Kyrgyzstan, Russia, Tajikistan, Turkmenistan, Uzbekistan].

### 9. *Onosma apiculatum* Riedl, Novon 5: 19. 1995.

细尖滇紫草 xi jian dian zi cao

Herbs perennial, with a rosette of leaves arising from either a stout vertical rhizome or from  $\pm$  horizontal branches. Stems solitary, ascending, 20–35 cm tall, unbranched, straw colored when dry; bristles dense, white, patent, ca. 2 mm, intermixed with very short patent hairs. Leaves of sterile rosette green, linear-spatulate to linear-oblongate, 4–13 cm  $\times$  4–8 mm, abaxially bristly mainly along midvein, sparsely bristly elsewhere, densely short pubescent as on stem, adaxially patent to  $\pm$  appressed white bristly, nearly flat tuberculate, base tapering, petiolelike, margin revolute, apex acute to  $\pm$  obtuse; uppermost leaves 2.5–4 cm, widest near base, apex acute. Cymes single or paired, involute, 4–6 cm at anthesis; lower bracts to 2 cm. Pedicel 2–5 mm. Calyx ca. 1.5 cm, elongated after anthesis; lobes linear, densely  $\pm$  appressed soft bristly and short pubescent, apex  $\pm$  obtuse. Corolla pale yellow, club-shaped, 2–2.2 cm, ca. 3 mm wide at base, ca. 8 mm wide slightly below lobes, very minutely papillate outside, glabrous inside and on nectary; lobes recurved, apiculate, ca. 1.5  $\times$  4.5 mm. Filaments ca. 7  $\times$  0.8 mm, tapering; anthers coherent, ca. 9.5 mm, fertile part ca. 3.5 mm; sterile tips truncate, exserted by less than 1 mm. Style exserted by 2.5–3 mm; stigma 2-lobed. Nutlets unknown. Fl. Jun.

- Woodlands; ca. 2100 m. Xinjiang.

*Onosma apiculatum* differs from *O. gmelinii* Ledebour by its green leaves, club-shaped corolla, and slightly longer anthers. From *O. irritans*, it differs by the markedly wider, indistinctly petiolate leaves, short hairs between bristles, shorter calyx, and club-shaped corolla. It differs from *O. baldshuanicum* Lipsky by its narrower, indistinctly petiolate leaves, denser bristles and short hairs, and shorter anthers. *Onosma apiculatum* differs from all three of these species by its shorter corolla, apiculate corolla lobes, and bracts longer than the calyx.

### 10. *Onosma gmelinii* Ledebour, Fl. Altaic. 1: 184. 1829.

黄花滇紫草 huang hua dian zi cao

Herbs perennial, gray-white, 25–40 cm tall, hispid, strigose. Stems single or several, cespitose, erect, not branched. Basal leaves long petiolate, oblanceolate, 10–12 cm  $\times$  5–10 mm, abaxially densely pubescent and hispid along veins and margin, adaxially densely appressed hispid and short strigose, base attenuate, apex obtuse; stem leaves sessile, lanceolate, 2–5 cm  $\times$  ca. 5 mm. Inflorescences terminal, not branched, 4–6 cm wide at anthesis, with numerous crowded flowers; bracts lanceolate, 1–1.5 cm,

densely hispid, short strigose. Pedicel short, ca. 5 mm. Calyx (1.2–)1.5 cm, to 2 cm in fruit, densely hispid, short strigose, parted nearly to base; lobes linear-lanceolate. Corolla yellow, tubular-campanulate, 2–2.5 cm, base ca. 2 mm wide, gradually expanded upward; throat 5.5–7.5 mm wide, obscurely pubescent outside, glabrous inside; lobes broadly triangular, ca. 2  $\times$  3 mm. Filaments subulate, 9–10 mm, decurrent, exserted; anthers united laterally, ca. 1 cm, included, apex sterile, ca. 2 mm. Style 1.6–2.2 cm, included, glabrous. Nectary ca. 1 mm, glabrous. Nutlets gray-brown, ca. 5 mm, lustrous, smooth, gradually tapering to beak, not gibbous. Fl. May–Jun.

Arid rocky slopes; ca. 1200 m. N Xinjiang (Fuyun Xian) [Kazakhstan, Kyrgyzstan, Mongolia, Russia, Tajikistan, Turkmenistan, Uzbekistan].

### 11. *Onosma paniculatum* Bureau & Franchet, J. Bot. (Morot) 5: 104. 1891.

滇紫草 dian zi cao

*Onosma oblongifolium* W. W. Smith & Jeffrey; *O. paniculatum* var. *hirsutistylum* Lingelshiem & Borza.

Herbs biennial, rarely perennial, 40–80 cm tall, blackened after drying. Stems single, not branched, 5–10 mm in diam. at base, spreading hispid and densely strigose, hairs discoid at base. Basal leaves linear-lanceolate or oblanceolate, 10–12  $\times$  1–2.5(–3) cm, base attenuate, apex acuminate. Upper and middle stem leaves lanceolate or ovate-triangular, 3–7  $\times$  1–2 cm, base hastate,  $\pm$  clasping, apex acuminate. Inflorescences terminal, elongated racemose after anthesis; bracts triangular. Pedicel slender, 0.7–1.7 cm. Calyx 7–8 mm, enlarged in fruit. Corolla blue-purple, becoming dark red, tubular-campanulate, 1.2–1.4 cm, densely strigose outside, strigose only along lobe midvein inside; throat 5–6 mm wide; nectary ca. 0.5 mm, densely villous; lobes broadly triangular, margin revolute. Filaments decurrent, 4–5 mm, pubescent, inserted 3–4 mm above base of corolla tube; anthers laterally united, ca. 7 mm, included or slightly exserted, apex sterile, ca. 2 mm. Nutlets dark brown, 2–3 mm, not shiny, tuberculate. Fl. and fr. Jun–Sep.

Arid slopes, forest margins; 2000–2300 m. W Guizhou, SW and W Sichuan, C and NW Yunnan [Bhutan, NE India].

The roots, which contain a purple dye, are used as a substitute for *Lithospermum erythrorhizon* in Chinese medicine.

### 12. *Onosma lijiangense* Y. L. Liu, Acta Phytotax. Sin. 22: 320. 1984.

丽江滇紫草 li jiang dian zi cao

Herbs perennial, ca. 30 cm tall, spreading hispid, strigose. Stems several, cespitose, woody, erect or ascending, branched from base. Leaves petiolate, lanceolate, 2.5–4 cm  $\times$  5–8 mm, base cuneate or nearly rounded, apex obtuse. Inflorescences terminal, paniculate. Pedicel pendulous or geniculately recurved, 1–1.5 cm, densely spreading hispid, short strigose, scabrous. Calyx 6–7 mm, slightly enlarged after anthesis, parted nearly to base; lobes lanceolate to linear-lanceolate. Corolla red, tubular-campanulate, 1.2–1.4 cm, base 1.5–2 mm wide, gradually expanded upward; throat

ca. 5 mm wide, above middle densely pubescent outside, glabrescent inside; nectary ca. 0.5 mm, densely white pubescent; lobes broadly triangular, ca. 1.5 × 2 mm, margin revolute. Filaments subulate, 4–4.5 mm, sparsely pubescent, base decurrent, inserted ca. 4 mm above base of corolla tube; anthers laterally united, ca. 7 mm, included; apex sterile, ca. 1 mm. Style ca. 1.5 cm, densely pubescent below middle. Nutlets unknown. Fl. Aug.

• In tussocks on hillsides; ca. 2700 m. NW Yunnan (Lijiang Xian).

**13. *Onosma wardii*** (W. W. Smith) I. M. Johnston, J. Arnold Arbor. 32: 215. 1951.

德钦滇紫草 de qin dian zi cao

*Onosma hookeri* C. B. Clarke var. *wardii* W. W. Smith, Notes Roy. Bot. Gard. Edinburgh 9: 113. 1916.

Herbs perennial, dark gray, ca. 60 cm tall, sparsely spreading hispid and pubescent. Stems single, erect. Lower and middle stem leaves petiolate, linear-lanceolate, ca. 10 × 0.5–1.2 cm; upper stem leaves lanceolate, 3–6 cm × 5–10 mm, abaxially gray, densely pubescent and strigose, adaxially hispid and pubescent, base rounded, apex acuminate; 3-veined. Inflorescences terminal, paniculate; bracts lanceolate, 3–10 mm. Pedicel 6–7 mm, spreading hispid. Calyx 0.8–1.2 cm; lobes linear-lanceolate, hispid, short strigose. Corolla 1–1.3 cm, tubular-campanulate, 1.5–2 mm wide at base, gradually expanded upward; throat 5–8 mm wide, strigose above middle except for nectaries, glabrous inside; nectary ca. 0.5 mm, 10-lobed, villous. Filaments ca. 5 mm, inserted ca. 3.5 mm above base of corolla tube; anthers laterally united, 5–6 mm, included; base decurrent, 1–1.5 mm, apex sterile. Style 1.3–1.5 cm, glabrous. Nutlets brown, ovoid, ca. 3 mm, tuberculate, papillate. Fl. and fr. Nov.

• Meadows; 2200–2800 m. NW and W Yunnan.

**14. *Onosma confertum*** W. W. Smith, Notes Roy. Bot. Gard. Edinburgh 8: 106. 1913.

密花滇紫草 mi hua dian zi cao

*Onosma forrestii* W. W. Smith.

Herbs perennial, 30–70 cm tall, with thick taproots. Stems single or several, cespitose, erect, not branched, densely hispid and short strigose, hairs discoid at base. Basal leaves oblanceolate or linear-lanceolate, 8–12 cm × 5–10 mm, apex acute. Middle and upper stem leaves lanceolate, 5–10 × 0.5–1.5 cm, abaxially gray-white, densely strigose, adaxially green and white spotted. Inflorescences terminal and axillary, solitary or branched into a spreading or crowded panicle. Pedicel slender, 6–10 mm, to 1.5 cm in fruit. Calyx lobes linear-lanceolate, 1–1.3 cm. Corolla red or purple, 1.2–1.7 cm, densely strigose outside, strigose only along lobe midvein inside; nectary 5-lobed, densely villous; lobes broadly triangular, ca. 1.5 × 2–2.5 mm. Filaments ca. 5 mm, decurrent part expanded, inserted 2–3.5 mm above base in corolla tube; anthers laterally united 6.5–8 mm, included or slightly exerted. Style 1.4–1.7 cm, glabrous. Nutlets gray-brown, ca. 3 mm, tuberculate, shiny. Fl. and fr. Jul–Oct.

• Thickets; 2300–3300 m. Sichuan (Muli Xian), NW Yunnan.

**15. *Onosma waltonii*** Duthie, Bull. Misc. Inform. Kew 1912: 41. 1912.

西藏滇紫草 xi zang dian zi cao

Herbs perennial, ca. 15 cm tall. Stems woody, branched, usually spreading, sparsely hispid, short strigose. Leaf blade oblong-lanceolate, 1–2.5 cm × 4–6 mm, abaxially light green, densely pubescent and sparsely hispid, adaxially green, densely hispid and short strigose, hairs discoid at base, base rounded, slightly clasping. Inflorescences solitary, terminal, not branched, 1–2 cm wide at anthesis. Pedicel slender, ca. 3 mm. Calyx 6–7 mm; lobes lanceolate, hispid outside, densely white villous inside. Corolla blue, 1–1.3 cm, base ca. 2 mm wide, gradually expanded upward; throat 5–7 mm wide, obscurely pubescent outside; nectary ca. 0.2 mm, glabrescent; lobes erect, triangular, ca. 1.5 × 2 mm, margin revolute. Filaments slender, 3–3.5 mm, inserted 4–4.5 mm above base of corolla tube, decurrent part linear, 2.3–3 mm, minutely pubescent, appearing mealy; anthers laterally united, included or slightly exerted; apex sterile, ca. 0.5 mm. Style 1.2–1.4 cm, glabrous. Nutlets light yellow, ca. 2.5 mm, shiny, obscurely tuberculate, wrinkled. Fl. and fr. Aug.

• Arid hillsides; ca. 3700 m. Xizang (Jiangzi Xian).

**16. *Onosma maaikangense*** W. T. Wang ex Y. L. Liu, Acta Phytotax. Sin. 18: 64. 1980.

马尔康滇紫草 ma er kang dian zi cao

Herbs perennial, 30–40 cm tall. Stems erect, much branched, spreading hispid, short strigose. Leaf blade oblong, 2–3 cm × 5–10 mm, strigose and hispid, abaxially light green, pubescent along veins, adaxially green, base cuneate or rounded, apex obtuse. Inflorescences terminal and axillary, widely spaced, spreading panicles; bracts lanceolate, 4–5 mm. Pedicel 6–12 mm. Calyx 6–7 mm; lobes lanceolate, ca. 1 mm wide. Corolla blue-purple or purple, 1–1.2 cm, base 1.5–2 mm wide; throat 6–7 mm wide, densely strigose outside; nectary ca. 0.5 mm, pubescent; lobes triangular, ca. 2 × 3 mm, margin revolute. Filaments subulate, 3–4 mm, not decurrent, base expanded, triangular, inserted 2–2.5 mm above base in corolla tube; anthers laterally united, 7.5–8 mm, included or apex slightly exerted, apex sterile, 1–1.5 mm. Style ca. 1.2 cm, glabrous. Nutlets brown, ca. 2.5 mm, densely papillate, sparsely tuberculate. Fl. and fr. Jun–Aug.

• Hillsides, roadsides; 2300–3800 m. Sichuan, E Xizang (Tiantaweng Shan).

**17. *Onosma liui*** Kamelin & T. N. Popova, Novon 3: 263. 1993.

壤塘滇紫草 rang tang dian zi cao

*Onosma strigosum* Y. L. Liu (1980), not Steven (1851).

Herbs ca. 60 cm tall. Stems several, cespitose, slender, branched from base, sparsely hispid, strigose. Leaf blade oblong-lanceolate or oblanceolate, 1–3 cm × 3–5 mm, abaxially hispid and densely short strigose, adaxially

appressed hispid, base cuneate or rounded, apex obtuse. Inflorescences terminal, branched, 1–3 cm at anthesis. Pedicel slender, 2–3 mm, slightly elongated in fruit, hispid, short strigose. Calyx 2.5–3.5 mm; lobes narrowly lanceolate. Corolla tubular-campanulate, 6–8 mm, base 1–1.5 mm wide, gradually expanded upward; throat 4.5–5.5 mm wide, densely short strigose outside, scabrous inside, strigose; nectary ca. 0.5 mm, densely pubescent; lobes broadly triangular, ca. 1.5 × 2 mm, apex recurved. Filaments subulate, base extremely expanded, inserted in villous area 1.5–2 mm above base of corolla tube; anthers laterally united, 6–7 mm, almost completely exerted. Style 0.9–1.1 cm, glabrous. Nutlets dirty gray-brown, ca. 2.5 mm, densely fine papillate, tuberculate. Fl. and fr. Jul.

- Slopes, roadsides; 2300–3400 m. Sichuan.

**18. *Onosma fistulosum*** I. M. Johnston, J. Arnold Arbor. 32: 222. 1951.

管状滇紫草 guan zhuang dian zi cao

Herbs biennial, ca. 1 m tall. Stems stout, 0.8–1.4 cm in diam. at base, hollow, hispid. Basal leaves lanceolate, to 35 cm, widest at middle, 4–6 cm, base attenuate, apex acuminate; lateral veins conspicuous; middle stem leaves ca. 15 × 2.5–3 cm, gradually reduced upward, hispid and strigose, hairs discoid at base. Inflorescences terminal and axillary, in more crowded panicles. Pedicel 5–10 mm, slender. Calyx lobes narrowly lanceolate, 0.9–1.2 cm × 1–1.5 mm, yellow hispid, short strigose. Corolla pink or purple-red, 1.1–1.4 cm, 1.5–2 mm wide at base, abruptly expanded at middle; throat 5–8.5 mm wide, strigose above middle outside, glabrous except for nectaries inside; nectary ca. 0.5 mm, pubescent; lobes broadly triangular, 1–1.5 × 2.5–4 mm, margin revolute. Filaments subulate, 7–9 mm, not decurrent, glabrous, inserted 3–4 mm above base in corolla tube; anthers laterally united, 7–8 mm, almost completely exerted, apex sterile, 1.5–2 mm. Style 1.4–1.6 cm, glabrous. Nutlets gray-brown, ca. 3 × 2 mm, shiny, black striate, obscurely tuberculate. Fl. and fr. Jul–Sep.

- Thickets, *Quercus* forests; 1600–3000 m. SW Sichuan.

**19. *Onosma decastichum*** Y. L. Liu, Acta Phytotax. Sin. 18: 67. 1980.

易门滇紫草 yi men dian zi cao

Herbs perennial, ca. 45 cm tall, pallid, hispid, densely retrorse pubescent. Stems single, not branched. Basal leaves narrowly lanceolate, 3–6 cm × 3.5–6 mm, abaxially densely tomentose, adaxially hispid and pubescent, base attenuate, apex acute; stem leaves crowded, lanceolate, 3–8 × 1–1.5 cm, abaxially gray-white, densely tomentose, adaxially green, hispid and pubescent, base rounded, apex acuminate; main veins 3, lateral veins conspicuous. Inflorescences terminal and axillary, in densely flowered panicles ca. 10 cm; bracts lanceolate, 5–10 mm. Pedicel ca. 3 mm, slender. Calyx 5–6 mm, densely white pubescent, parted nearly to base; lobes linear-lanceolate. Corolla blue-purple, tubular-campanulate, ca. 1 cm, base 1.5–2 mm wide, gradually expanded upward;

throat 3–4 mm wide, densely short strigose outside, 10-ranked, sparsely short hispid inside and between lobes; nectary ca. 0.3 mm, 10-lobed, white villous; lobes triangular-lanceolate, 2–2.5 × 1–1.5 mm, apex recurved. Filaments subulate, inserted 2–2.5 mm above base of corolla tube; anthers laterally united, 7–7.5 mm, almost completely exerted. Style 1.3–1.5 cm. Nutlets gray-brown, 2–2.5 mm, shiny. Fl. Oct.

- Meadows, thickets; ca. 1300 m. C Yunnan.

*Onosma decastichum* resembles *O. burmanicum* Collett & Hemsley (Myanmar), but the latter has glabrous corollas inside and dark, shiny nutlets 3–3.5 mm.

**20. *Onosma sinicum*** Diels, Bot. Jahrb. Syst. 29: 547. 1900.

小叶滇紫草 xiao ye dian zi cao

*Onosma potaninii* Popov.

Herbs perennial, suffrutescent, 15–30 cm tall. Stems branched from base, hispid, strigose; branches erect, ascending to prostrate, 5–15 cm; old branches woody, lacinate. Leaf blade oblanceolate, 1–1.5 cm × 2–5 mm, hispid along margin and veins, abaxially gray-green, strigose, with many short hairs, adaxially green, hispid and strigose, base attenuate into a petiole, apex acute to obtuse. Inflorescences solitary, rarely branching, terminating branches, ca. 5 cm at anthesis; bracts lanceolate to ovate-lanceolate, ca. 3 mm. Pedicel ca. 3 mm at anthesis, to 9 mm in fruit. Calyx lobes linear to linear-lanceolate, 7–9 × ca. 1 mm, hirsute, strigose. Corolla blue, 8–9.5 mm; throat 4–5 mm wide, strigose outside above, villous inside near filament insertion; nectary ca. 0.5 mm, villous. Filaments 5–7 mm, not decurrent, base slightly expanded, densely villous, inserted 2.5–3 mm above base of corolla tube; anthers laterally united, 6–7 mm, apex sterile, 0.5–1 mm, nearly completely exerted. Nutlets brown, 2–2.5 mm, densely tuberculate. Fl. May–Jul., fr. Aug.

- Dry banks, ravines, rocky hillsides, *Quercus* forests; 1700–3200 m. S Gansu, N Sichuan.

**21. *Onosma farreri*** I. M. Johnston, J. Arnold Arbor. 32: 345. 1951.

小花滇紫草 xiao hua dian zi cao

*Onosma sinicum* Diels var. *farreri* (I. M. Johnston) W. T. Wang & Y. L. Liu.

Subshrubs grayish. Stems simple or with few branches at apex, 20–30 cm tall, slender, spreading bristly and short strigose, hairs discoid at base. Leaf blade oblanceolate, 1.5–3 cm × 2–4 mm, abaxially densely strigose, adaxially spreading hispid and densely strigose, tubercles discoid at base. Cymes ca. 4 × 1–2 cm in fruit. Pedicel to 6 mm. Calyx ca. 6 mm at anthesis; lobes 0.5–1 mm. Corolla blue, 1.1–1.2 cm, 2–2.5 mm wide at base, to 3–5 mm wide toward lobes, folded below sinuses above middle, antrorsely strigose, minutely puberulent outside, glabrous inside except for a few hairs on nectary. Filaments not decurrent, inserted ca. 3 mm from base, gradually tapering toward anthers; anthers ca. 8 mm, united

into a tube, sterile apex ca. 1 mm, located 1–2 mm below sinuses of corolla. Nutlets unknown. Fl. Apr.

• Dry hillsides, open sandy areas. Gansu, Shaanxi (Taibai Shan).

**22. *Onosma luquanense*** Y. L. Liu, Acta Phytotax. Sin. 18: 67. 1980.

禄劝滇紫草 lu quan dian zi cao

Herbs biennial, gray-green, 40–70 cm tall, hispid, short strigose. Stems several, cespitose, woody, erect or ascending, branched above middle; branches crowded, 7–12 cm. Leaf blade lanceolate, 2–6 cm × 3–10 mm, abaxially pubescent and sparsely hispid, adaxially densely hispid, base cuneate or rounded, apex obtuse. Inflorescences terminal, 1–1.5 cm in diam. at anthesis, to 5–7 cm in fruit, racemose, many flowered; bracts ovate-lanceolate, 5–10 mm, hispid and pubescent. Flowers crowded. Calyx 5–7 mm, parted nearly to base; lobes linear-lanceolate, hispid outside, densely pilose. Corolla tubular-campanulate, 8–10 mm; throat 4–5 mm wide, short strigose outside, 1-ranked pubescent along lobe midvein inside; nectary ca. 0.5 mm, pubescent; lobes triangular, margin revolute, apex caudate, acute, recurved. Filaments subulate, 4.5–5.5 mm, not decurrent, inserted ca. 2.5 mm above base in corolla tube; anthers laterally united, 5–7 mm, almost completely exerted, sterile apex ca. 2.5 mm. Style ca. 1.4 cm, glabrous. Nutlets dark gray, ca. 2.5 mm, not shiny, densely fine papillate, sparsely tuberculate. Fl. and fr. Oct.

• Hillsides; ca. 1900 m. N Yunnan.

**23. *Onosma album*** W. W. Smith & Jeffrey, Notes Roy. Bot. Gard. Edinburgh 9: 112. 1916.

白花滇紫草 bai hua dian zi cao

Herbs perennial, gray-white, 40–60 cm tall, densely hispid, short strigose, extremely scabrous. Stems single, erect, not branched. Basal leaves linear-lanceolate, 3–8 cm × ca. 5 mm, densely hispid, abaxially densely white pubescent and sparsely hispid, adaxially strigose, base attenuate, apex acute; stem leaves lanceolate or linear-lanceolate, 4–6 cm × 4–7 mm, abaxially pubescent, adaxially densely hispid and strigose, base rounded, apex acuminate. Inflorescences terminal and axillary, in widely spaced panicles; bracts ovate-lanceolate, 5–10 mm. Pedicel slender, 5–8 mm, densely hispid, slightly elongated after anthesis. Calyx 7–9 mm, densely hispid outside, densely pilose inside, parted nearly to base; lobes linear-lanceolate. Corolla white, tubular-campanulate, 8–10 mm; throat 3.5–5 mm wide, upper 1/3 pubescent outside, only lobe midvein pubescent inside; nectary ca. 0.5 mm, white villous; lobes erect, triangular, ca. 1.5 mm, margin revolute. Filaments 6–7.5 mm, decurrent part pubescent, inserted ca. 3 mm above base of corolla tube; anthers laterally united, ca. 9 mm, mostly exerted, sterile apex ca. 2 mm. Style 1.6–1.7 cm, sparsely pubescent below middle. Fl. Jul.

• Hillsides, open forests, gravelly and sandy areas; ca. 3000 m. NW Yunnan.

**24. *Onosma yajiangense*** W. T. Wang ex Y. L. Liu, Acta Phytotax. Sin. 18: 64. 1980.

雅江滇紫草 ya jiang dian zi cao

Herbs perennial, gray-white, ca. 30 cm tall, appressed hispid, pubescent. Stems frequently cespitose, not branched. Basal leaves long petiolate, narrowly oblanceolate, 1.4–1.8 cm × 4–10 mm, abaxially densely strigose and hispid along veins, adaxially hispid and strigose, base attenuate, apex obtuse; upper and middle stem leaves sessile, lanceolate, 3–6 cm × 5–10 mm, 3-veined. Inflorescences terminal and axillary, in panicles 4–8 × 8–12 cm; bracts lanceolate, 3.5–6 mm. Pedicel slender, 5–7 mm, densely hispid, strigose. Calyx 7–9 mm, densely hispid, strigose, parted nearly to base; lobes lanceolate. Corolla tubular-campanulate, ca. 1 cm, 1–1.5 mm wide at base; throat 4–5.5 mm wide, densely yellow strigose outside, only lobe midvein white pubescent inside; nectary ca. 0.5 mm, white villous; lobes broadly triangular, ca. 1.5 × 2 mm, margin revolute, apex caudate. Filaments ca. 5.5 mm, decurrent part pubescent, inserted 3.5–4 mm above base in corolla tube; anthers laterally united, ca. 7.5 mm, almost completely exerted. Style ca. 1.2 cm, exerted, glabrous. Nutlets unknown. Fl. Jul.

• W Sichuan.

**25. *Onosma adenopus*** I. M. Johnston, J. Arnold Arbor. 32: 224. 1951.

腺花滇紫草 xian hua dian zi cao

Herbs perennial, 20–30 cm tall. Stems several, cespitose, erect or ascending, densely hispid, short strigose. Basal leaves forming a rosette; leaf blade oblanceolate or lanceolate, 2–4 cm × 7–10 mm, densely hispid, base broadly cuneate or rounded, apex obtuse or acute; stem leaves lanceolate or oblong, 2–4.5 cm × 3–10 mm, abaxially densely hispid, adaxially densely hispid and short strigose, densely white pilose along veins and margin, only midvein evident. Inflorescences terminal and axillary, to 3–5 cm after anthesis, becoming racemose. Pedicel slender, 2–3 mm, elongated in fruit, densely hispid. Flowers crowded. Calyx 5–7 mm, parted to base; lobes linear, less than 1 mm wide, hispid outside, pubescent inside. Corolla blue-purple or light purple, tubular-campanulate, 8–10 mm; throat 3.5–5 mm wide; nectary ringlike, membranous, glabrous; lobes broadly triangular, 1–1.5 × ca. 2.5 mm, lobe midvein densely pubescent outside, glabrescent inside. Filaments subulate, 5–6 mm, not decurrent, base and nearby part of corolla tube papillate and glandular, inserted 3–3.5 mm above base of corolla tube; anthers laterally united, mostly exerted, apex sterile, 2–3 mm. Style 1–1.5 cm, glabrous. Nutlets yellow-white, 2–3 mm, wrinkled, tuberculate. Fl. and fr. Aug-Sep.

• Hillsides, benches in arid valleys; 2800–3500 m. C, NW and SW Sichuan, E Xizang.

**26. *Onosma nangqenense*** Y. L. Liu, Acta Phytotax. Sin. 18: 68. 1980.

囊谦滇紫草 nang qian dian zi cao

Herbs erect, spreading hispid, appressed pubescent. Stems single, branched above. Leaves sessile, ovate-lanceolate or linear-lanceolate, 3–7 × 1–1.5 cm, 3-veined, abaxially densely strigose, sparsely hispid along veins and margin, adaxially scabrous, hispid, or minutely hispid, hairs discoid at base, base rounded or cuneate, apex obtuse. Inflorescences terminal, becoming racemose, stout, 12–15 cm; bracts ovate-lanceolate, 2–3 × 0.5–1.5 cm. Pedicel stout, 5–10 mm. Calyx lobes lanceolate, 7–9 × 1–2 mm, densely hispid and short strigose outside, villous inside. Corolla pink, tubular-campanulate, 1.1–1.2 cm; throat 3–6 mm wide, glabrous inside except midvein of lobe 1-ranked pubescent; nectary ringlike, membranous, glabrous; lobes broadly triangular, ca. 1.5 × 2.5–3 mm, margin revolute. Filaments subulate, 5–5.5 mm, decurrent at base, inserted ca. 3.5 mm above base in corolla tube; anthers laterally united, 7–7.5 mm, mostly exerted, apex sterile, 1.5–2 mm. Style 1.5–1.7 cm, glabrous. Nutlets gray-brown, ca. 3 mm, tuberculate, finely papillate. Fl. and fr. Aug.

- Shaded hillsides. S Qinghai.

**27. *Onosma multiramosum*** Handel-Mazzetti, Anz. Akad. Wiss. Wien. Math.-Nat. Kl. 61: 166. 1924.

多枝滇紫草 duo zhi dian zi cao

*Onosma multiramosum* var. *mekongense* I. M. Johnston.

Herbs perennial, gray-green, ca. 30 cm tall. Stems erect, much branched, sparsely hispid and densely pubescent, hairs discoid at base. Lower stem leaves oblanceolate, 5–7 mm; middle stem leaves oblong-lanceolate, 3–4 cm × 6–10 mm, abaxially densely pilose, along midvein and margin sparsely hispid, adaxially hispid, pubescent, base attenuate, apex acuminate. Inflorescences solitary, terminal, 1–2 cm wide at anthesis. Pedicel 2–3 mm. Calyx lobes linear-lanceolate, 7–8 mm, densely villous inside, slightly shorter than corolla tube. Flower buds curved at apex. Corolla yellow, tubular-campanulate, 8–9 mm, ca. 1.5 mm wide at base; throat 4–4.5 mm wide, upper 1/3 densely short hispid outside; nectary ca. 0.5 mm, 5-lobed, pubescent; lobes broadly triangular, appressed pubescent inside, margin revolute. Filaments subulate, 5–6 mm, inserted ca. 3.5 mm above base in corolla tube, decurrent part linear, 1.5–2 mm; anthers laterally united, blue-purple, ca. 9 mm, curved at apex, mostly exerted, apex sterile, ca. 3 mm. Style 1.3–1.5 cm, glabrous. Nutlets 2.5–3 mm, wrinkled, tuberculate. Fl. and fr. Aug.

- Valleys, arid slopes; 1600–3100 m. SW Sichuan, E Xizang, NW Yunnan.

**28. *Onosma waddellii*** Duthie, Bull. Misc. Inform. Kew 1912: 41. 1912.

丛茎滇紫草 cong jing dian zi cao

*Onosma waddellii* var. *brachylinum* I. M. Johnston.

Herbs annual or biennial, rarely perennial, green, 15–25 cm tall, densely appressed pubescent, sparsely hispid. Stems single or several, caespitose, erect to ascending, branched from base; branches extremely crowded. Leaves sessile, lanceolate or oblanceolate, 1–3 cm × 3–6 mm, abaxially densely strigose, margin and midvein hispid, adaxially hispid and strigose, base cuneate, apex obtuse. Inflorescences numerous, terminal, to 4–6 cm after anthesis, becoming racemose; bracts ovate-lanceolate, 3–7 mm. Pedicel 1–3 mm, densely spreading hispid. Flowers crowded. Calyx 5–8 mm, parted nearly to base; lobes lanceolate. Corolla blue, tubular-campanulate, 0.8–1.2 cm; throat 4–9 mm wide; nectary obscurely pubescent; lobes broadly triangular, short appressed pubescent, otherwise obscurely pubescent outside, glabrous inside except for nectary, margin revolute. Filaments 6.5–7 mm, decurrent part linear, inserted 3.4–4 mm above base in corolla tube, mealy pubescent; anthers laterally united, 5–6 mm, mostly or completely exerted. Nutlets light yellow-brown, 2–2.5 mm, shiny, sparsely tuberculate, obscurely wrinkled. Fl. and fr. Aug-Sep.

- Meadows, gravelly slopes; 3000–4000 m. Xizang.

**29. *Onosma exsertum*** Hemsley, Hooker's Icon. Pl. 27: t. 2637. 1900.

露蕊滇紫草 lu rui dian zi cao

Herbs biennial, 60–100 cm tall. Stems single, much branched above, stout, 5–12 mm in diam. at base, densely hispid and strigose, hairs discoid at base. Basal leaves oblanceolate, ca. 30 × 7 cm, apex obtuse; middle stem leaves lanceolate or oblong-lanceolate, 5–10 × 1.5–4 cm, base rounded, apex acute or obtuse; upper stem leaves 3–5 × ca. 1 cm. Inflorescences numerous, terminal, in spreading panicles, ca. 20 cm; bracts long ovate. Pedicel slender, 5–10 mm. Calyx 6–8 mm; lobes lanceolate, densely appressed hispid. Corolla red, later becoming blue-purple, 7–8 mm, ca. 1 mm wide, densely short strigose outside above, sparsely pubescent along lobe midvein inside, base ca. 1 mm wide; throat 3–3.5 mm wide; nectary ringlike, ca. 0.2 mm, glabrous; lobes broadly triangular, margin revolute. Filaments subulate, 7–9 mm, decurrent, inserted 2.5–3 mm above base of corolla tube; anthers laterally united, 5–6 mm, completely exerted, sterile apex ca. 1 mm. Style 1.5–1.7 cm, glabrous. Nutlets ca. 3 mm, glossy, wrinkled. Fl. Jun.

- Open hillsides, meadows, *Pinus* and *Quercus* forests; 1800–2100 m. Guizhou, SW Sichuan, Yunnan.

### 13. ECHIUM Linnaeus, Sp. Pl. 1: 139. 1753.

蓝薊属 lan ji shu

Herbs annual, biennial, or perennial, strigose. Leaf blade lanceolate. Cymes terminating stems and branches, or in panicles. Flowers frequently pedicellate. Calyx 5-parted; lobes lanceolate-linear, less often broadly lanceolate, slightly enlarged, connivent

in fruit, 2 adaxial lobes usually smaller. Corolla blue, purple, or pink, campanulate or tubular, distinctly zygomorphic, usually pubescent outside; tube usually short, with a pubescent or glabrous protective ring inside base, throat unappendaged; limb oblique, lobes unequal in size. Stamens unequal; filaments thin, long, attached at different levels at or below middle of corolla tube, appearing spirally arranged, often exerted; anthers oblong, small. Ovary 4-divided. Style filiform, exerted, appressed pubescent, apex 2-cleft, each branch with a small capitate stigma. Gynobase flat. Nutlets usually light brown, straight, ovoid or narrowly ovoid, tuberculate or smooth; attachment scar at base.

Over 40 species: Africa, W Asia, Europe, introduced to North America; one species in China.

**1. *Echium vulgare* Linnaeus, Sp. Pl. 1: 139. 1753.**

藍薊 lan ji

Herbs biennial. Stems usually erect, to 1 m, usually much branched, spreading hirsute, densely short appressed pubescent. Basal and lower stem leaves linear-lanceolate, ca. 12 × 1.4 cm, long strigose, base attenuate; upper stem leaves sessile, lanceolate, smaller. Inflorescences long, narrow, many flowered; bracts narrowly lanceolate, 4–15 mm. Flowers somewhat crowded. Calyx 5-parted to base, hirsute

outside; lobes lanceolate-linear, ca. 6 mm, to 1 cm in fruit. Corolla blue-purple, oblique-campanulate, ca. 1.2 cm, short appressed pubescent outside; lobes unequal, upper lobe larger. Filaments 1–1.2 cm; anthers oblong, ca. 0.5 mm. Style ca. 1.4 cm; stigma terminal. Nutlets ovoid, ca. 2.5 mm, tuberculate.  $2n = 16, 32 (31, 33, 34)$ .

Rocky areas. N Xinjiang [Kazakhstan, Kyrgyzstan, Russia, Tajikistan, Turkmenistan, Uzbekistan; W Asia, Europe, North America].

**14. PULMONARIA Linnaeus, Sp. Pl. 1: 135. 1753.**

肺草属 fei cao shu

Herbs perennial, hirsute. Stems often unbranched. Basal leaves petiolate, large. Cymes terminal, bracteate. Flowers pedicellate. Calyx campanulate, 5-lobed, enlarged in fruit, subtending nutlet. Corolla violet-red or blue; tube ca. as long as calyx; throat unappendaged or with bundles of hairs; limb spreading, 5-parted. Stamens included; filaments extremely short; anthers oblong. Ovary 4-lobed. Style filiform; stigma capitate, 2-cleft. Gynobase flat. Nutlets straight, ovoid, smooth, shiny, acutely keeled adaxially, apex obtuse; attachment scar at base, slightly concave, margin ringlike, with umbilical tissue.

About 14 species: C Asia, Europe; one species in China.

**1. *Pulmonaria mollissima* A. Kerner, Monogr. Pulmon. 47. 1878.**

腺毛肺草 xian mao fei cao

Roots black-brown, rather thick. Stems erect, somewhat branched above, 20–25 cm tall, short glandular pubescent, hispid. Basal leaves withered after anthesis; petiole 8–18 cm; leaf blade oblong-elliptic, 10–30 × 2–7 cm, short strigose, base attenuate, apex acuminate; stem leaves sessile, oblong-lanceolate to narrowly ovate, 5–12 × 1.5–2.5 cm, base attenuate or subcordate, apex acuminate. Inflorescences to

8 cm; bracts lanceolate, 0.6–1.4 cm. Calyx narrowly campanulate, 8–11 mm, short glandular pubescent, hispid, lobed to 1/3 length; lobes triangular. Corolla violet-blue, broadly tubular, wider at upper part, ca. 1.4 cm; lobes spreading, nearly semiorbicular, unappendaged at throat. Stamens inserted below throat; anthers ca. 2 mm. Style reaching middle of corolla tube. Nutlets slightly compressed laterally, ca. 3.5 mm, subglabrous.  $2n = 14, 18, 28 (26, 27)$ .

Wooded hillsides, valleys, moist shaded areas. Nei Mongol, Shanxi [Kazakhstan, Kyrgyzstan, Mongolia, Russia, Tajikistan, Turkmenistan, Uzbekistan; SW Asia, Europe].

**15. ANCHUSA Linnaeus, Sp. Pl. 1: 133. 1753.**

牛舌草属 niu she cao shu

*Lycopsis* Linnaeus.

Herbs annual or perennial, sparsely strigose or hispid, rarely soft appressed pubescent. Stems erect or spreading. Leaves alternate. Cymes terminal, widely spaced in fruit, scorpioid; bracts lanceolate. Calyx 5-parted nearly to base or less; lobes equal or unequal, linear to triangular, often slightly enlarged in fruit. Corolla blue-purple or yellowish, regular or slightly zygomorphic; tube usually longer than calyx, straight or arcuate or geniculate curved; throat appendages scaly or tuberculate and short pubescent; limb campanulate; lobes 5, equal or unequal, apex obtuse. Stamens inserted at or below middle of corolla tube, included; filaments short, filiform; anthers ovate-oblong, apex obtuse. Ovary 4-divided. Style included in corolla tube; stigma capitate, 2-cleft. Gynobase flat. Nutlets straight, reniform, or oblique-ovoid, reticulate-wrinkled; attachment scar at or near base, margin ringlike, thickened, hardened.

About 50 species: N Africa, C and W Asia, Europe; one species in China.

**1. *Anchusa ovata*** Lehmann, Pl. Asperif. Nucif. 1: 122. 1818.

狼紫草 lang zi cao

*Anchusa orientalis* (Linnaeus) Reichenbach; *Lycopsis arvensis* Linnaeus subsp. *orientalis* (Linnaeus) Kuntze; *L. orientalis* Linnaeus.

Herbs annual. Stems branching usually from base, 10–40 cm tall, sparsely spreading hirsute. Basal and lower stem leaves petiolate, oblanceolate to linear-oblong, 4–14 × 1.2–3 cm, sparsely hirsute, margin undulate, denticulate. Cymes short at anthesis, becoming gradually elongated, to 25 cm; bracts ovate to linear-lanceolate, smaller than leaves. Pedicel ca. 2 mm, to 1.5 cm in fruit. Calyx ca. 7 mm, semiappressed hispid; lobes somewhat unequal, subulate, enlarged in fruit, substellate spreading. Corolla blue-purple, sometimes reddish

purple, ca. 7 mm, glabrous; tube below middle slightly geniculate curved; appendages densely short pubescent; lobes spreading, wider than long. Stamens inserted below middle of corolla tube; filaments extremely short; anthers ca. 1 mm. Style ca. 2.5 mm. Nutlets bright brown, reniform, 3–3.5 × ca. 2 mm, finely tuberculate; attachment scar near base, cupular, margin without teeth. Seeds brown; cotyledons narrowly oblong. Fl. and fr. May-Jul.  $2n = 16, 48$ .

Hillsides, marshes, field margins. Gansu, Hainan, Hebei, Nei Mongol, Ningxia, Qinghai, Shaanxi, Shanxi, Xinjiang, Xizang [Afghanistan, N India, Kazakhstan, Kyrgyzstan, Mongolia, Nepal, Pakistan, Russia, Tajikistan, Turkmenistan, Uzbekistan; NE Africa, SW Asia, SE Europe].

The seeds contain an edible oil. *Anchusa orientalis* Linnaeus is a different species, blocking the transfer of the epithet from *Lycopsis*.

**16. *NONEA* Medikus, Philos. Bot. 1: 31. 1789.**

假狼紫草属 jia lang zi cao shu

Plants annual or perennial, hispid or strigose. Leaves alternate. Cymes elongated after anthesis, becoming racemose; bracts leaflike. Flowers crowded at anthesis. Calyx tubular-campanulate, 5-lobed from upper 1/3 to middle, turgid saccate; lobes long triangular. Corolla blue-purple or yellow; tube straight; appendages scaly, below throat in upper part of tube; lobes spreading, overlapping, apex obtuse. Stamens included or slightly exerted; anthers oblong, obtuse, or mucronate. Ovary 4-divided. Style not exerted from corolla; stigma globose, or style 2-cleft at apex. Gynobase flat. Nutlets slightly curved, reniform to subglobose, reticulate-wrinkled, glabrous or sparsely pubescent; attachment scar on lower part adaxially, concave, with ringlike margin and umbilical emergence.

About 35 species: Africa, W Asia, Europe; one species in China.

**1. *Nonea caspica*** (Willdenow) G. Don, Gen. Hist. 4: 336. 1838.

假狼紫草 jia lang zi cao

*Onosma caspica* Willdenow, Sp. Pl. 1: 775. 1797; *Lycopsis caspica* (Willdenow) Lehmann; *L. picta* Lehmann; *Nonea picta* (Lehmann) Fischer & C. A. Meyer.

Herbs annual. Stems usually branched from base, 5–25 cm tall; branches ascending to decumbent, hispid, short strigose, with glandular hairs. Leaves sessile, hispid, sparsely hirsute. Basal and lower stem leaves linear-oblanceolate, 3–6 cm × 4–10 mm; upper stem leaves linear-lanceolate, smaller. Inflorescences to 15 cm after anthesis, short strigose and hirsute. Pedicel ca. 3 mm; bracts linear-lanceolate, 1.5–5 cm.

Calyx 5–8 mm, 5-parted to middle; lobes lanceolate-triangular. Corolla purple-red, 0.8–1.2 cm; appendages below throat 2-lobed; limb to 1/3 as long as tube; lobes ovate to suborbicular, margin entire or subdentate. Stamens inserted slightly above middle in corolla tube, included; anthers ca. 1.4 mm. Style ca. 4 mm; stigma subglobose, slightly 2-cleft. Gynobase slightly convex. Mature nutlets black-brown, reniform, ca. 4 mm, glabrous or sparsely pubescent before maturity, horizontally wrinkled, apex keeled; attachment scar cupular, margin finely dentate. Seeds gray-brown, reniform; radicle superior; cotyledons obovate-oblong.  $2n = 16, 28, 44$ .

Slopes, foothills, valley terraces. N Xinjiang [Afghanistan, Kazakhstan, Kyrgyzstan, Mongolia, Pakistan, Russia, Tajikistan, Turkmenistan, Uzbekistan; SW Asia, E Europe].

**17. *GASTROCOTYLE*** Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg Ser. 6, Sci. Math., Seconde Pt. 7: 405. 1854.

腹脐草属 fu qi cao shu

Herbs short strigose, bristly. Leaves alternate, sessile, margin obtusely incised-dentate or undulate. Flowers solitary in leaf axils, short pedicellate or ± sessile. Calyx 5-parted nearly to base; lobes stellate spreading. Corolla 5-parted; tube ca. 2 × as long as lobes; throat with 5 scaly pilose appendages; limb divided; lobes spreading, overlapping in bud. Stamens included, below

appendages. Ovary 4-divided. Stigma subcapitate. Nutlets erect, fissured-wrinkled, densely tuberculate; attachment scar adaxial, oblong, margin thickened.

Two species: Afghanistan, India, Pakistan, SW Asia; one species in China.

**1. *Gastrocotyle hispida*** (Forsskål) Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg Ser. 6, Sci. Math., Seconde Pt. 7: 405. 1854.

腹脐草 fu qi cao

*Anchusa hispida* Forsskål, Fl. Aegypt.-Arab. 40. 1775.

Herbs annual, gray-white, ca. 40 cm tall, strigose, hispid, hairs discoid at base. Stems branched from base; branches spreading, evidently striate. Leaf blade narrowly oblong to lanceolate-oblong, 1–2 cm × 4–8 mm, slightly fleshy, short strigose, sparsely bristly, base rounded to broadly cuneate, rarely cordate, margin angular-dentate, sometimes

subundulate, apex obtuse. Pedicel 1.5–2 mm. Calyx 1.5–2.5 mm, to 3.5 mm after anthesis, densely bristly outside and short strigose inside; lobes lanceolate. Corolla blue or purple, tubular, ca. 3 mm wide at limb, ca. 1 mm wide at base, ca. 1.5 mm wide at throat, densely short strigose outside, glabrous inside; appendages trapeziform, pilose; lobes orbicular, ca. 1 mm. Anthers ovate, ca. 0.5 mm. Style ca. 1 mm; stigma capitate. Nutlets light brown, 3.5–4.5 mm, attachment scar ca. 3 mm.

Saline and alkaline soils; 0–1500 m. SE Xinjiang [Afghanistan, N and W India, Pakistan; N Africa, SW Asia].

## 18. SYMPHYTUM Linnaeus, Sp. Pl. 1: 136. 1753.

聚合草属 ju he cao shu

Herbs perennial. Roots thickened, hispid or strigose. Stem leaves sometimes decurrent. Cymes terminal, becoming paniculate, bracteate. Calyx 5-parted to middle or below; lobes unequal, slightly elongated in fruit. Corolla light purple-red, rarely yellow, tubular-campanulate; throat appendages 5, lanceolate, with papillate glands; limb 5-lobed; lobes triangular to semiorbicular, margin dentate, apex sometimes revolute. Stamens inserted at throat, not exerted; anthers linear-oblong. Ovary 4-parted. Style filiform, usually exerted; stigma capitate. Gynobase flat. Nutlets ovoid, sometimes suboblique, usually granular-tuberculate, reticulate-wrinkled, rarely smooth; attachment scar at base, cupular, finely dentate at margin.

About 20 species: Asia, Europe, cultivated worldwide; one species in China.

**1. *Symphytum officinale*** Linnaeus, Sp. Pl. 1: 136. 1753.

聚合草 ju he cao

Herbs forming tussocks, 30–90 cm tall, arcuate hispid, short strigose. Main roots purplish brown, stout. Stems erect or ascending, branched. Basal leaves long petiolate, lorate-lanceolate to ovate, 30–60 × 10–20 cm, apex acuminate; middle and upper stem leaves sessile, smaller, base decurrent. Inflorescences many flowered. Calyx parted nearly to base; lobes lanceolate, apex acuminate. Corolla light purple, purple-red, or yellowish white, 1.4–1.5 cm; throat appendages ca. 4

mm, not exerted beyond limb; lobes triangular, apex revolute. Filaments ca. 3 mm; lower part nearly as wide as anthers; anthers ca. 3.5 mm, apex with somewhat prominent connective. Ovary usually sterile, occasionally only 1 mericarp develops in a few flowers. Nutlets black, oblique ovoid or ovoid, 3–4 mm, smooth, shiny. Fl. May–Oct.  $2n = 24 + 0-4b$ , 26, 32–45\*, 46–48, 56.

Forests. Fujian, Hebei, Liaoning, Taiwan, Xinjiang [Kazakhstan, Kyrgyzstan, Russia, Tajikistan, Turkmenistan, Uzbekistan; Europe].

This species was introduced in China in 1963 as green forage for livestock.

## 19. MYOSOTIS Linnaeus, Sp. Pl. 1: 131. 1753.

勿忘草属 wu wang cao shu

Herbs annual or perennial, short pubescent or glabrescent. Leaves alternate. Cymes becoming racemelike after anthesis, ebracteate or rarely with few bracts. Calyx 5-lobed or parted, slightly enlarged or not in fruit. Corolla blue or white, rarely light purple, usually salverform, rarely campanulate or funnellform; throat appendages 5, scalelike; lobes 5, spreading, rotund, margin convolute. Stamens included; anthers ovate to elliptic, apex obtuse. Ovary 4-parted. Style linear; stigma discoid, mucronate. Gynobase flat or slightly convex. Nutlets 4, usually ovate, appressed, lenticular, vertical, smooth, shiny; attachment scar basal.

About 50 species: Africa, Asia, Australia, Europe, North America; five species in China.

1a. Calyx 5-lobed for 1/2–2/3 its length, sparsely strigose outside.

2a. Pedicel 6–8 mm in fruit; nutlets ovoid; lower stem nodes without roots; leaf blade oblanceolate to oblong .....

2. *M. caespitosa*

2b. Pedicel to 22 mm in fruit; nutlets triangular; lower stem nodes with roots; leaf blade oblong

- to narrowly oblong ..... 3. *M. bothriospermoides*
- 1b. Calyx 5-lobed nearly to base, densely pubescent with straight and hooked hairs.
- 3a. Stems usually diffuse; inflorescences few flowered; pedicel reflexed or recurved, to 15 mm; nutlet base with fleshy pubescent appendages ..... 1. *M. sparsiflora*
- 3b. Stems erect; inflorescences many flowered; pedicel erect, 4–6 mm in fruit; nutlet base without appendages
- 4a. Rhizomes slender, producing separate lax sterile shoots to 10 cm tall and flowering stems ..... 5. *M. krylovii*
- 4b. Rhizomes stout, producing 1 to several fertile stems 20–45 cm tall ..... 4. *M. alpestris*

**1. *Myosotis sparsiflora*** Mikan, Bot. Taschenbuch 74. 1807.

稀花勿忘草 xi hua wu wang cao

*Strophostoma sparsiflorum* (Mikan) Turczaninow.

Herbs annual. Stems diffuse, much branched at base, 15–25 cm tall; branches spreading, sparsely pilose with hooked hairs. Lower stem leaves obovate or lanceolate, 2–3 × 0.8–1.2 cm, sparsely pilose, base attenuate, decurrent and forming a wing, apex obtuse to ± acute. Upper stem leaves sessile, ovate-lanceolate to elliptic, apex acute. Inflorescences terminal on branches, ebracteate. Pedicel reflexed or recurved, to 1.5 cm in fruit, densely pubescent, with hooked hairs. Flowers few and scattered; upper flowers several. Calyx 1.5–2 mm, slightly enlarged in fruit, to 4–5 mm; lobes lanceolate, ca. 2/3 as long as calyx, densely spreading pilose, with hooked hairs, apex acuminate. Corolla light blue-purple, ca. 2 × 3 mm; lobes ovate, ca. as long as corolla tube. Anthers ovate, apex with orbicular appendages. Nutlets ovoid, ca. 2 × 1–1.2 mm, smooth, shiny, with light yellow, fleshy, pubescent appendages at base.  $2n = 18$ .

Marshes, moist places. Xinjiang (Gongliu Xian, Tien Shan) [Kazakhstan, Kyrgyzstan, Russia, Tajikistan, Turkmenistan, Uzbekistan; SW Asia, C Europe].

**2. *Myosotis caespitosa*** C. F. Schultz, Prodr. Fl. Starg. Suppl. 1: 11. 1819.

湿地勿忘草 shi di wu wang cao

*Myosotis lingulata* Lehmann; *M. scorpioides* Linnaeus subsp. *caespitosa* (C. F. Schultz) Hermann; *M. uliginosa* Schrader.

Herbs perennial, with dense fibrous adventitious roots. Stems unbranched, sometimes branched, 15–50(–70) cm tall, sparsely strigose. Lower stem leaves petiolate, oblong to oblanceolate, 2–3 cm × 3–8 mm, sparsely strigose, base attenuate, margin entire, apex obtuse; upper stem leaves sessile, oblanceolate to linear-lanceolate, 3–7 cm × 5–13 mm. Inflorescences elongated after anthesis, to 10–20 cm in fruit, ebracteate, or lower several flowers from axils of linear bracts. Pedicel divaricate, 6–8 mm in fruit, usually longer than calyx. Calyx campanulate, cuneate at base, 5-lobed nearly to middle, ca. 2 mm, to 3–4 mm in fruit; lobes triangular, stiff, sparsely strigose outside, apex obtuse. Corolla light blue, 2–3 mm; tube ca. as long as calyx; throat yellow, with 5 appendages; limb 3–4 mm wide; lobes divaricate, ovate, ca. 1.5 mm. Anthers elliptic, ca. 0.6 mm, upper appendages rounded, ca. 3 × as long as anthers. Nutlets dark brown, ovoid, 1.5–2 mm, smooth, narrowly marginate above, apex obtuse.  $2n = 22, 44, 48, 86, 88$ .

Stream banks, moist places, slopes. Gansu, Hebei, Heilongjiang, Jilin, Liaoning, Sichuan, Xinjiang, Yunnan [N Africa, temperate and subtropical Asia, Europe, North America].

**3. *Myosotis bothriospermoides*** Kitagawa, Rep. Inst. Sci. Res. Manchoukuo 4: 41. 1936.

承德勿忘草 cheng de wu wang cao

Herbs with ascending stems rooting on lower nodes, often branched. Branches sparsely strigose. Stem leaves sessile, oblong to narrowly oblong, sparsely strigose, base attenuate, apex obtuse. Inflorescences widely spaced, strongly elongated after anthesis. Pedicel 1.5–2.5 mm, to 2.2 cm after anthesis. Calyx ca. 3.5 mm, to 6 mm in fruit, sparsely strigose outside; lobes narrowly ovate-oblong, ca. 2.6–3 mm in fruit, margin ciliate, apex ± acute to obtuse. Corolla blue, ca. 3.5 mm; tube ca. 1.5 mm. Filaments inserted at middle of corolla tube, ca. 0.4 mm; anthers elliptic, apex with rounded membranous appendages. Ovary smooth, ca. 0.5 mm. Style linear, ca. 1.2 mm, smooth. Nutlets dark brown, dorsiventrally compressed, adaxially nearly flat, deltoid, 1.6–1.7 × 1.5–1.6 mm, shiny, base broadly cuneate, margin narrow, abaxially convex, apex obtuse.

• Moist areas. Hebei (Chengde Xian).

**4. *Myosotis alpestris*** F. W. Schmidt, Fl. Boem. Cent. 3: 26. 1794.

勿忘草 wu wang cao

*Myosotis alpestris* subsp. *asiatica* Vestergren ex Hultén; *M. imitata* Sergievskaja; *M. suaveolens* Waldstein & Kitaibel; *M. sylvatica* Ehrhart subsp. *alpestris* Koch.

Herbs perennial. Stems single, erect or caespitose, 20–45 cm tall, sparsely spreading strigose, sometimes cottony. Basal and lower stem leaves petiolate, narrowly oblanceolate to linear-lanceolate, to 8 cm × 5–12 mm, strigose, hairs discoid at base, base attenuate, decurrent into a wing, margin entire, apex rounded to ± acute; upper stem leaves sessile, smaller. Inflorescences to 15 cm after anthesis, ebracteate. Pedicel erect in fruit, 4–6 mm, densely short strigose. Calyx 1.5–2.5 mm, to 4–5 mm in fruit, parted nearly to base; lobes lanceolate, with densely spreading or hooked hairs, apex acuminate. Corolla blue; tube ca. 2.5 mm; throat appendages ca. 0.5 mm; limb 6–8 mm wide; lobes 5, orbicular, ca. 3.5 mm. Anthers elliptic, apex with an orbicular appendage. Nutlets dark brown, ovoid, ca. 2 × 1 mm, smooth, shiny, base without appendages, margin narrow.  $2n = 14, 24, 30, 48, 70, 72$ .

Forest margins, slopes, meadows. Gansu, Hebei, Heilongjiang, Jiangsu, Jilin, Liaoning, Nei Mongol, Ningxia, Qinghai, Shaanxi,

Shandong, Shanxi, Sichuan, Xinjiang, Yunnan [Afghanistan, N India, Kashmir, Kazakhstan, Kyrgyzstan, Pakistan, Russia, Tajikistan, Turkmenistan, Uzbekistan; SW Asia, Europe, North America].

**5. *Myosotis krylovii*** Sergievskaya, Sist. Zametki Mater. Gerb. Krylova Tomsk. Gosud. Univ. Kiybyseva, 6-7: 6. 1936.

细根勿忘草 xi gen wu wang cao

Herbs biennial. Rhizomes producing elongated sterile shoots and flowering stems, to 10 cm tall. Stems very delicate with widely spaced cymes. Basal leaves oval, tapering

abruptly into a long petiole; lower leaves short petiolate; upper leaves sessile, oblong-lanceolate, 2-5 cm × 5-13 mm, sparsely pubescent, apex acute. Axis of cymes slightly flexuous. Pedicel filiform, sometimes slightly curved, 3-4 mm. Calyx ca. 2 mm, accrescent after anthesis; lobes grayish, linear-lanceolate, with hooked hairs at base of calyx. Corolla blue; tube ca. 2 mm; limb 5(-10) mm wide. Nutlets black, ca. 1.5 mm, shiny, apex acute.

Coniferous forests. Xinjiang (Altay Shan and adjacent areas) [Kazakhstan, Kyrgyzstan, Mongolia, Russia, Tajikistan, Turkmenistan, Uzbekistan].

## 20. TRIGONOTIS Steven, Bull. Soc. Imp. Naturalistes Moscou 24(1): 603. 1851.

附地菜属 fu di cai shu

Herbs perennial, biennial, or rarely annual. Stems single or several and cespitose, erect to diffuse, hispid or pilose, rarely glabrous. Cymes solitary or dichotomously branched, ebracteate or lower pedicels bracteate, rarely all bracteate (flowers extra-axillary). Calyx 5-lobed or 5-parted, not enlarged or slightly enlarged in fruit. Corolla blue or white; tube usually shorter than calyx; throat appendages 4, lunate or trapeziform; lobes 5, spreading, overlapping. Stamens included; anthers oblong to elliptic. Ovary 4-parted. Style linear, usually shorter than corolla tube; stigma included, capitate. Gynobase flat. Nutlets 4, semiglobose-tetrahedral or subulate trigonous-tetrahedral, shiny, glabrous or pubescent, rarely tuberculate, adaxial 3 surfaces subequal in size or bottom smaller than 2 lateral surfaces, longitudinal vein at juncture of 2 lateral surfaces, sessile or with a short carpophore from corner of 3 adaxial surfaces, abaxial surfaces flattened or convex, acute or obtuse ribbed, rarely narrow winged; attachment scar at bottom of carpophore or at corner of 3 adaxial surfaces when sessile. Embryo vertical; cotyledon ovate.

About 58 species: Asia, E Europe; 39 species in China, of which 34 are endemic.

1a. Nutlets semiglobose-tetrahedral.

2a. Nutlet tuberculate, adaxially crustaceously obtuse ribbed.

3a. Corolla white; bracts present on lowermost 1 or 2 flowers of inflorescences ..... 12. *T. nandanensis*

3b. Corolla blue to purple; bracts absent.

4a. Inflorescences sessile ..... 11. *T. macrophylla*

4b. Inflorescences conspicuously pedunculate.

5a. Peduncle 1-4 cm; leaf blade lanceolate, densely strigose ..... 8. *T. compressa*

5b. Peduncle to 1 cm; leaf blade broadly ovate to elliptic or orbicular, sparsely strigose.

6a. Leaf blade ovate to broadly elliptic, apex obtuse to emarginate; calyx lobes oblanceolate; corolla 3.5-4 mm wide ..... 9. *T. mairei*

6b. Leaf blade orbicular to broadly elliptic, apex retuse, mucronate; calyx lobes narrowly ovate; corolla 5-6 mm wide ..... 10. *T. orbicularifolia*

2b. Nutlet smooth, glabrous, shiny, neither tuberculate nor ribbed.

7a. Corolla appressed puberulent; leaf blade to 6 cm; lateral veins prominent adaxially ..... 13. *T. heliotropifolia*

7b. Corolla glabrous; leaf blade less than 5 cm; lateral veins not prominent.

8a. Inflorescences bracteate throughout; pedicel twisted or recurved ..... 1. *T. delicatula*

8b. Inflorescences ebracteate or only lower half or lowermost 2 or 3 flowers bracteate; pedicel usually ascending.

9a. Plants gray-white villous.

10a. Leaf blade broadly ovate to rotund; corolla limb ca. 2.5 mm wide; calyx lobes obtuse at apex; stipe of nutlet straight ..... 6. *T. mollis*

10b. Leaf blade narrowly elliptic; corolla limb 5-6 mm wide; calyx lobes acuminate at apex; stipe of nutlet curved ..... 7. *T. vestita*

9b. Plants hispid.

11a. Corolla limb ca. 7 mm wide; leaf blade orbicular to reniform; nutlet ± sessile ..... 2. *T. rotundata*

11b. Corolla limb 4-6 mm wide; leaf blade oblong to elliptic; stipe of nutlet 0.2-0.3 mm.

12a. Stems densely gray hispid; leaves sessile; corolla 5-6 mm wide ..... 5. *T. barkamensis*

12b. Stems sparsely hispid or minutely strigose; leaves petiolate; corolla 3.5-4 mm wide.

13a. Stems much branched at base, strigose; stem leaves oblong; inflorescences with leaflike bracts to middle; angle at inner surface of nutlet indistinct ..... 3. *T. corispermoides*

13b. Stems unbranched or with 1 lateral branch, minutely strigose; stem

- leaves narrowly ovate to elliptic; inflorescences with 1 or 2 basal bracts only; angle at inner surface of nutlet obtuse ..... 4. *T. chengkouensis*
- 1b. Nutlets trigonous-tetrahedral, inverted to oblique, subulate.
- 14a. Nutlets with adaxial 3 surfaces subequal in size, sessile, attachment scar basal, abaxial surfaces triangular; inflorescences ebracteate.
- 15a. Leaf blade broadly ovate to broadly elliptic.
- 16a. Stems with sterile branches to 75 cm; leaf blade elliptic to rotund; pedicel ca. as long as calyx ..... 16. *T. omeiensis*
- 16b. Stems without sterile branches; leaf blade broadly ovate to broadly lanceolate; pedicel 1–2 × as long as calyx.
- 17a. Calyx lobes broadly ovate, obtuse, ca. 2 mm; inflorescences dichotomously branched ..... 14. *T. cavaleriei*
- 17b. Calyx lobes oblanceolate, acute, 2–3 mm; inflorescences with cymes 2- or 3-fascicled ..... 39. *T. funingensis*
- 15b. Leaf blade lanceolate to oblong.
- 18a. Corolla white.
- 19a. Corolla 5–6 mm wide; calyx lobes lanceolate, apex acute; pedicel 3–7 mm ..... 19. *T. nankotaizanensis*
- 19b. Corolla 4–5 mm wide; calyx lobes obovate-spatulate, apex obtuse; pedicel 1–3 mm ..... 18. *T. elevatovenosa*
- 18b. Corolla blue.
- 20a. Corolla deep blue ..... 15. *T. leyeensis*
- 20b. Corolla light blue.
- 21a. Plants with runners ..... 17. *T. formosana*
- 21b. Plants without runners.
- 22a. Leaf blade lanceolate, apex acuminate; middle and upper stem leaves ± sessile; pedicel 5–6 mm; nutlets abaxially slightly convex, acutely 3-ribbed ..... 20. *T. giraldii*
- 22b. Leaf blade elliptic to elliptic-ovate, apex obtuse to acute; middle and upper stem leaves short petiolate; pedicel 2–4 mm; nutlets abaxially flattened or slightly concave, narrowly ribbed or winged.
- 23a. Nutlet cluster fastigiate, acute; corolla (2–)4–5 mm wide ..... 22. *T. laxa*
- 23b. Nutlet cluster cross-shaped; corolla 2–2.5 mm wide ..... 21. *T. floribunda*
- 14b. Nutlets with adaxial bottom surfaces and abaxial ones usually arcuate-convex, adaxial bottom surface smaller, 2 lateral surfaces equal in size; inflorescences bracteate at least basally.
- 24a. Inflorescences bracteate.
- 25a. Stems single, erect to spreading, without runners; nutlets glabrous, ca. 1 mm ..... 23. *T. bracteata*
- 25b. Stems usually cespitose, erect becoming creeping; nutlets pubescent, ca. 2 mm ..... 24. *T. radicans*
- 24b. Inflorescences bracteate only at base.
- 26a. Plants annual or biennial; corolla white or light blue.
- 27a. Corolla white or light blue, ca. 3 mm wide; carpophore of nutlet curved ..... 37. *T. tibetica*
- 27b. Corolla white, ca. 4 mm wide; carpophore absent ..... 38. *T. leucantha*
- 26b. Plants perennial, rarely ?biennial; corolla blue or purple.
- 28a. Junction of calyx tube with pedicel distinctly thickened, clavate in fruit ..... 36. *T. peduncularis*
- 28b. Junction of calyx tube and pedicel not clavate.
- 29a. Corolla 7–8 mm wide ..... 35. *T. rockii*
- 29b. Corolla not exceeding 6 mm wide.
- 30a. Nutlet ca. 2 mm, without carpophore; corolla ca. 6 mm wide ..... 25. *T. myosotideae*
- 30b. Nutlet 1–1.3 mm, with or without carpophore; corolla 3–5 mm wide.
- 31a. Plants cespitose, ca. 20 cm.
- 32a. Corolla 1.7–2.2 mm wide ..... 28. *T. harrismithii*
- 32b. Corolla ca. 3 mm wide.
- 33a. Leaf blade cordate to orbicular-ovate, apex acute; calyx lobes lanceolate; stipes of nutlets ± straight to ± curved ..... 26. *T. tenera*
- 33b. Leaf blade oblong to rotund, apex rounded, mucronate; calyx lobes ovate; stipes of nutlets distinctly curved, short ..... 27. *T. petiolaris*
- 31b. Plants not cespitose, 20–60 cm.
- 34a. Stems gray strigose; leaves subleathery ..... 34. *T. cinereifolia*
- 34b. Stems green strigose; leaves herbaceous.
- 35a. Corolla purple; fruiting pedicel 0.9–1.6 cm; stems branched from base upward ..... 29. *T. longipes*

- 35b. Corolla bluish; fruiting pedicel to 1 cm, if longer than stems simple or branched near base only.
- 36a. Fruiting pedicel to 2 cm ..... 30. *T. gracilipes*
- 36b. Fruiting pedicel to 0.8 cm.
- 37a. Nutlets ca. 1.2 mm; lateral leaf veins indistinct ..... 31. *T. muliensis*
- 37b. Nutlets ca. 1 mm; lateral leaf veins distinct at least adaxially.
- 38a. Lateral leaf veins 3 pairs, prominent, strigose abaxially; branches short ..... 32. *T. microcarpa*
- 38b. Lateral leaf veins 2 pairs, visible abaxially, scarcely prominent, pubescent; branches elongated ..... 33. *T. longiramosa*

**1. *Trigonotis delicatula*** Handel-Mazzetti, Anz. Akad. Wiss. Wien Math.-Nat. Kl. 62: 26. 1925.

扭梗附地菜 niu geng fu di cai

*Trigonotis contortipes* I. M. Johnston.

Herbs biennial, gray-white strigose. Stems numerous, cespitose, branched below, 15–35 cm tall. Basal leaves withered at anthesis; petiole of lower leaves 0.6–2 cm; stem leaves oblong to oblong-obovate, 0.6–2 cm × 6–10 mm, strigose, abaxially pallid, base decurrent to petiole, margin entire, apex rounded, mucronate; midvein prominent; upper leaves sessile. Inflorescences extra-axillary, bracteate. Pedicel thin, frequently twisted or recurved, 3–15 mm, strigose. Calyx lobes oblong, ca. 1.5 mm, gray strigose, apex obtuse. Corolla blue; tube ca. 1.5 mm; throat appendages fleshy, sparsely pubescent; limb ca. 5 mm wide; lobes 5, divaricate, orbicular, ca. 2.5 mm. Stamens inserted at middle of corolla tube; filaments ca. 0.8 mm; anthers oblong, ca. 0.5 mm. Nutlets pallid or brown, semiglobose-tetrahedral, appressed, 1.5–2 mm, smooth, glabrous, shiny, adaxial bottom surface protruding and prominent, 2 lateral surfaces slightly concave, with a longitudinal rib on border line, abaxial surfaces triangular, center line adaxially obscure, without stipe. Fl. Jul–Aug, fr. Aug–Sep.

• Open forests, alpine meadows, rocky crevices; 3000–4200 m. Sichuan (Muli Xian), N Yunnan.

**2. *Trigonotis rotundata*** I. M. Johnston, J. Arnold Arbor. 18: 7. 1937.

圆叶附地菜 yuan ye fu di cai

Herbs perennial, strigose. Rhizomes prostrate. Stems 7–20 cm tall. Petiole of basal and lower stem leaves 3–4 cm, base expanded; leaf blade orbicular to subreniform, 0.7–1.7 cm wide, finely strigose, base rounded to cordate, apex rounded to retuse, mucronate; middle and upper stem leaves short petiolate, smaller. Inflorescences terminal, lowermost 1 or 2 flowers bracteate. Pedicel ascending, 5–10 mm. Calyx 5-lobed to above middle; lobes lanceolate, ca. 2 mm, strigose. Corolla light blue; throat appendages retuse, pubescent at apex; limb 5-lobed, ca. 7 mm wide; lobes broadly obovate, ca. 3 mm. Anthers elliptic, ca. 0.6 mm, apex obtuse. Nutlets semiglobose-tetrahedral, ca. 1 × 1 mm, ± sessile, smooth, glabrous, shiny.

• Alpine meadows, subalpine thickets, forest margins; 3000–

4000 m. Sichuan, N Yunnan.

**3. *Trigonotis corispermoides*** C. J. Wang, Acta Bot. Yunnan. 4: 35. 1982.

虫实附地菜 chong shi fu di cai

Herbs perennial, cespitose. Stems ascending to erect, much branched at base, to 40 cm tall, strigose. Basal and lower stem leaves usually withered at anthesis; petiole 1.5–5 cm; leaf blade oblong to elliptic, 1–1.5 cm × 4–6 mm, densely strigose, base cuneate to rounded, apex obtuse, mucronate; middle and upper stem leaves short petiolate or subsessile, oblong, smaller. Inflorescences basal; middle and lower parts with leaflike bracts. Pedicel obliquely spreading, 3–8 mm in fruit. Calyx 5-parted; lobes lanceolate, ca. 1 mm, to 2 mm in fruit, strigose. Corolla light red; tube ca. 1.5 mm, ca. 2 mm wide; throat appendages ca. 0.4 mm, apex retuse; limb 3.5–4 mm wide; lobes 5, obovate. Anthers elliptic, ca. 0.5 mm. Nutlets gray-brown, semiglobose-tetrahedral, ca. 1.3 mm, smooth, glabrous, shiny, adaxial bottom surface smaller than 2 lateral surfaces, abaxial surfaces ovate and convex, narrowly ribbed around margin, apex rounded, obtuse.

• Meadows, roadsides; ca. 2900 m. Sichuan, Yunnan.

*Trigonotis corispermoides* closely resembles *T. gracilipes* I. M. Johnston but differs by having nutlets with rhomboid-ovate abaxial surfaces, more broadly ribbed margins, and the 3 adaxial surfaces equal in size.

1a. Nutlets stipitate, stipe ca. 0.2

mm ..... 3a. var. *corispermoides*

1b. Nutlets sessile ..... 3b. var. *sessilis*

**3a. *Trigonotis corispermoides* var. *corispermoides***

虫实附地菜 (原变种) chong shi fu di cai (yuan bian zhong)

Nutlets stipitate, stipe ca. 0.2 mm.

• Hillside meadows, roadsides; ca. 2900 m. Sichuan (Barkam Xian), NW Yunnan.

**3b. *Trigonotis corispermoides* var. *sessilis*** W. T. Wang, Bull. Bot. Res., Harbin 6(3): 81. 1986.

无柄虫实附地菜 wu bing chong shi fu di cai

Nutlets without stipe.

- Sichuan.

**4. *Trigonotis chengkouensis*** W. T. Wang, Bull. Bot. Res., Harbin 6(3): 81. 1986.

城口附地菜 cheng kou fu di cai

Stems unbranched or with 1 lateral branch, slender, 10–28 cm tall, minutely strigose. Petiole of basal leaves slender, 1.2–3.8 cm; leaf blade ovate, 6–13 × 4–10 mm, abaxially sparsely minute strigose, adaxially densely minute strigose, base rounded-truncate, apex obtuse or apiculate; lateral veins obscure; stem leaves long or short petiolate; leaf blade narrowly ovate to elliptic, base rounded or broadly cuneate. Inflorescences 2.5–7 cm, to 7–19 cm in fruit, 9–18-flowered; bracts subtending lowermost 1 or 2 flowers only. Pedicel slender, 1.5–8 mm. Calyx lobes linear-obovate, ca. 0.9 mm, minutely strigose outside, apex obtuse. Corolla blue, glabrous; tube ca. 1 mm, faucal appendages low trapeziform, ca. 0.5 mm; limb ca. 4 mm wide; lobes 5, suborbicular. Anthers ca. 0.4 mm. Pistil ca. 0.9 mm. Nutlets blackish brown, bifacial-tetrahedral, smooth, glabrous, shiny, lateral surfaces forming an obtuse angle; abaxial surfaces ca. 0.8 mm, deltate-ovate; stipe indistinct, ca. 0.2 mm. Fl. and fr. Aug.

- In rock crevices; ca. 1900 m. Sichuan.

**5. *Trigonotis barkamensis*** C. J. Wang, Acta Bot. Yunnan. 4: 36. 1982.

金川附地菜 jin chuan fu di cai

Herbs biennial. Stems single, much branched below, 20–28 cm tall; branches ascending, densely gray hispid. Basal leaves withered at anthesis; stem leaves sessile, oblong to long elliptic, 1.5–3.5 cm × 3–10 mm, densely strigose, base attenuate, decurrent to petiole, margin entire, apex obtuse. Inflorescences terminal, only basal 1 or 2 flowers bracteate. Pedicel 3–4 mm, divaricate. Calyx 5-parted; lobes vertical, linear-oblong, ca. 2 mm, slightly enlarged in fruit, tightly enclosing nutlets, ca. 1/3 longer than nutlets. Corolla light blue, 5–6 mm wide; tube ca. 2 mm, ca. as long as calyx; throat appendages trapeziform, ca. 0.7 mm, apex emarginate; lobes of limb obovate, ca. 2.5 × 2 mm. Anthers elliptic, ca. 0.7 mm. Nutlets gray-brown, semiglobose-tetrahedral, ca. 1 mm, smooth, glabrous, shiny, narrowly ribbed, adaxial bottom surface smaller than 2 lateral surfaces, 2 lateral surfaces longitudinally ribbed along border line, abaxial surfaces ovate and convex, apex obtuse; stipe ca. 0.3 mm.

- Hillside meadows; ca. 2200 m. Sichuan (Jinchuan Xian).

**6. *Trigonotis mollis*** Hemsley in F. B. Forbes & Hemsley, J. Linn. Soc., Bot. 26: 153. 1890.

湖北附地菜 hu bei fu di cai

Herbs perennial, densely gray pubescent. Stems densely cespitose, ascending, 15–20 cm tall, spreading pubescent. Petiole of basal leaves 3–4 cm; leaf blade broadly ovate to rotund, 0.5–1.5 × 0.5–1.5 cm, submembranous, densely gray

pubescent, base rounded to broadly cuneate, apex rounded or shallowly retuse, less often ± acute; stem leaves short petiolate, smaller. Inflorescences terminal, ca. 7 cm, only lower 1 or 2 flowers bracteate. Pedicel filiform, 2–6 mm, frequently horizontal. Flowers widely spaced. Calyx lobes obovate-spatulate, ca. 1.5 mm, slightly enlarged after anthesis, apex obtuse. Corolla light blue; limb ca. 2.5 mm wide; lobes suborbicular. Anthers elliptic, apex mucronate. Ovary glabrous. Style included. Nutlets gray-brown, semiglobose-tetrahedral, ca. 0.6 mm, smooth, glabrous, shiny, 2 lateral surfaces subequal in size, longitudinally ribbed at their juncture; abaxial surfaces convex, broadly ovate, 0.5–0.6 mm, apex acute.

- Rocky slopes, river banks; 900–1100 m. Hubei, Shaanxi.

**7. *Trigonotis vestita*** (Hemsley) I. M. Johnston, Contr. Gray Herb. 75: 47. 1925.

灰毛附地菜 hui mao fu di cai

*Trigonotis peduncularis* (Trevisan) Benth. ex Baker & S. Moore var. *vestita* Hemsley in F. B. Forbes & Hemsley, J. Linn. Soc., Bot. 26: 154. 1890.

Herbs biennial. Stems cespitose, ca. 15 cm tall, densely gray-white villous. Basal leaves numerous; petiole to 6 cm; leaf blade narrowly elliptic, 0.5–3 cm × 3–10 mm, densely gray-white villous, abaxially with prominent midvein, base narrowly cuneate, apex mucronate; stem leaves similar to basal leaves, sessile or extremely short petiolate. Inflorescences terminal, to 14 cm in fruit, only lower 2 or 3 flowers bracteate. Pedicel obliquely spreading, linear, 7–10 mm. Calyx 5-parted; lobes oblanceolate, ca. 2 mm, densely villous, apex acuminate. Corolla light blue; tube ca. 2.5 mm wide; throat appendages ca. 0.8 mm, papillate; limb 5–6 mm wide; lobes horizontal, suborbicular, ca. 2.5 mm. Anthers broadly elliptic, ca. 0.6 mm; apex obtuse. Nutlets dark brown, semiglobose-tetrahedral, ca. 1 mm, smooth, glabrous, shiny, adaxial bottom surface smaller than 2 lateral surfaces, abaxial surfaces ovate and convex; stipe slightly curved, ca. 0.2 mm.

- Alpine or subalpine meadows, thickets. Hubei, Shaanxi, Sichuan, Yunnan.

**8. *Trigonotis compressa*** I. M. Johnston, J. Arnold Arbor. 18: 4. 1937.

狭叶附地菜 xia ye fu di cai

Herbs perennial. Rhizomes ascending, dark brown; roots numerous, fibrous; crown covered by persistent petioles. Stems erect, 20–35 cm tall, sparsely strigose. Basal leaves withered at anthesis; petiole 0.5–5 cm; stem leaves lanceolate, 3–8 × 1.5–3 cm, abaxially densely strigose, slightly purplish, base cuneate to rounded, apex acuminate. Inflorescences solitary or paired, basal; peduncle 1–4 cm; middle and lower parts with leaflike bracts. Pedicel obliquely spreading, 3–8 mm in fruit. Calyx 5-parted; lobes lanceolate, ca. 1 mm, slightly enlarged, to 2 mm, strigose. Corolla light red; tube ca. 1.5 mm, ca. 2 mm wide; throat appendages ca. 0.4 mm, apex retuse; limb 3.5–4 mm wide; lobes obovate. Anthers elliptic, ca. 0.5 mm. Nutlets gray-brown, semiglobose-tetrahedral, ca. 1.3 mm, tuberculate, adaxial bottom surface smaller than 2

lateral surfaces, abaxial surfaces ovate and convex, narrowly ribbed around margin, apex rounded and obtuse; stipe ca. 0.2 mm.

• Hillside meadows, roadsides; ca. 2900 m. Sichuan (Barkam Xian), NW Yunnan.

*Trigonotis compressa* closely resembles *T. gracilipes*, but the latter has nutlets with broadly ribbed margins and equal, rhomboid-ovate adaxial surfaces.

**9. *Trigonotis mairei*** (H. Léveillé) I. M. Johnston, J. Arnold Arbor. 18: 4. 1937.

长梗附地菜 chang geng fu di cai

*Omphalodes mairei* H. Léveillé, Repert. Spec. Nov. Regni Veg. 12: 188. 1913; *Trigonotis muriculata* I. M. Johnston.

Herbs perennial. Rhizomes blackish. Stems erect, 40–50 cm tall, strigose; stem leaves widely spaced; petiole 2–7 cm; leaf blade ovate to broadly elliptic, 4–6 × 2.5–5 cm, sparsely strigose, apex obtuse to emarginate, mucronate. Inflorescences with distinct peduncles, to 10 cm, ebracteate. Pedicel obliquely spreading, to 4 mm in fruit. Calyx lobes oblanceolate, ca. 2.5 mm, strigose, apex acute. Corolla blue-purple; tube ca. 1.8 mm; throat appendages narrow, thin; limb 3.5–4 mm wide; lobes suborbicular, ca. 1.8 mm. Anthers elliptic, ca. 0.8 mm., apex rounded. Mature nutlets dark brown, semiglobose-tetrahedral, ca. 1 mm, dorsiventrally compressed, tuberculate, adaxial bottom surface convex, juncture of 2 lateral surfaces prominent; abaxial surfaces convex, crustaceous, narrowly ribbed around margin, sessile.

• Forests, meadows; 700–1300 m. Sichuan (Mabian Xian), Yunnan.

**10. *Trigonotis orbicularifolia*** C. J. Wang, Acta Bot. Yunnan., Suppl. 4: 37. 1982.

厚叶附地菜 hou ye fu di cai

Herbs perennial. Rhizomes ascending, dark brown; roots numerous, fibrous. Stems erect, 20–40 cm tall, short strigose. Basal leaves mostly withered at anthesis. Petiole 2–3 cm; stem leaves orbicular to broadly elliptic, 3–7 × 3–6.5 cm, abaxially gray-green, sparsely short strigose, hairs discoid at base, adaxially green, base rounded, decurrent, margin entire, apex retuse, mucronate; veins conspicuous. Inflorescences axillary, branched, to 28 cm in fruit, ebracteate. Pedicel divaricate, ca. 2 mm, 4–5 mm in fruit. Calyx parted nearly to base; lobes narrowly ovate, 2–2.5 mm, slightly enlarged in fruit, strigose, apex acuminate. Corolla light blue or white; tube ca. 2 mm; throat appendages ca. 0.4 mm; limb 5–6 mm wide; lobes rotate-horizontal, suborbicular, margin denticulate. Anthers elliptic, ca. 1 mm, apex obtuse. Style shorter than nutlets. Mature nutlets black, semiglobose-tetrahedral, ca. 1.5 mm, sparsely spinescent-tuberculate, 2 lateral surfaces equal in size and longitudinally ribbed at their juncture; abaxial surfaces convex becoming white, ovate, obtuse ribbed around margin, sessile. Fl. Jun–Jul, fr. Jul–Aug.

• Hillside meadows, forests, moist shaded valleys; 700–1800 m.

Sichuan.

**11. *Trigonotis macrophylla*** Vaniot, Monde Pl. 7: 42. 1905.

大叶附地菜 da ye fu di cai

Herbs perennial. Stems ascending, ca. 35 cm tall, sparsely short strigose or glabrescent. Petiole to 5 cm; leaf blade narrowly lanceolate to broadly ovate, 3.5–9 × 2.5–6.5 cm, sparsely strigose, base rounded to cuneate, apex mucronate. Upper stem leaves short petiolate, smaller. Inflorescences sessile, in axils of upper leaves, much branched, to 19 cm in fruit, strigose, ebracteate. Pedicel obliquely spreading, to 4 mm in fruit. Flowers widely spaced. Calyx lobes vertical, oblanceolate, ca. 2.5 mm. Corolla blue, light blue, or light purple. Mature nutlets black, vertical, semiglobose-tetrahedral, ca. 1 mm, adaxial bottom surface smaller, convex, 2 lateral surfaces subequal in size; abaxial surfaces extremely convex, margin crustaceous, obtuse ribbed, sessile.

• Forest margins, meadows, moist valleys. Guangdong, Guangxi, Guizhou, Sichuan.

- 1a. Leaf blade narrowly lanceolate to elliptic-lanceolate ..... 11b. var. *trichocarpa*  
1b. Leaf blade broadly ovate.  
2a. Calyx lobes ca. 2.5 mm; corolla blue or light blue ..... 11a. var. *macrophylla*  
2b. Calyx lobes ca. 2 mm; corolla light purple ..... 11c. var. *verrucosa*

**11a. *Trigonotis macrophylla* var. *macrophylla***

大叶附地菜 (原变种) da ye fu di cai (yuan bian zhong)

*Trigonotis pedunculata* var. *macrophylla* (Vaniot) H. Léveillé.

Leaf blade broadly ovate. Calyx lobes ca. 2.5 mm, oblanceolate. Corolla blue or light blue. Nutlets not bristly or punctate.

• Forest margins, meadows. Guizhou, Sichuan.

**11b. *Trigonotis macrophylla* var. *trichocarpa*** Handel-Mazzetti, Sinensia 5: 18. 1934.

毛果大叶附地菜 mao guo da ye fu di cai

Leaf blade narrowly lanceolate to elliptic-lanceolate. Calyx parted to base; lobes linear. Corolla blue or light blue. Nutlets sparsely bristly, not punctate.

• Hillside meadows, forest margins. N Guizhou, Sichuan (Jinfo Shan).

**11c. *Trigonotis macrophylla* var. *verrucosa*** I. M. Johnston, J. Arnold Arbor. 18: 4. 1937.

瘤果大叶附地菜 liu guo da ye fu di cai

Leaf blade broadly ovate. Calyx parted to base; lobes oblong, apex mucronate. Corolla light purple. Nutlets with fine granular punctations, not bristly.

• Hillside meadows, moist valleys, forest margins; 800–1500 m. NW Guangdong, NW Guangxi, S Guizhou.

The plants are used medicinally.

**12. *Trigonotis nandanensis*** C. J. Wang, Acta Bot. Yunnan., Suppl. 4: 38. 1982.

南丹附地菜 *nan dan fu di cai*

Herbs perennial. Rhizomes 3–4 cm, ca. 3 mm in diam., with numerous fibrous roots. Stems erect, 20–25 cm tall, densely spreading pubescent. Basal leaves numerous; petiole to 7 cm, densely pubescent; leaf blade ovate to oblong-ovate, 2–3.5 × 1–2.2 cm, abaxially more densely pubescent, adaxially sparsely pubescent, base rounded or somewhat cordate, apex rounded, mucronate; midvein raised abaxially; stem leaves widely spaced, petiole 1.5–3 cm. Inflorescences terminal, ca. 10 cm, only basal 1 or 2 flowers bracteate. Pedicel usually divaricate, filiform, 3–5 mm. Calyx lobes oblanceolate, ca. 2 mm, pubescent; apex acute. Corolla white; tube ca. 1.5 mm; limb 4–5 mm wide; lobes suborbicular, ca. 2 mm wide. Anthers elliptic, ca. 0.5 mm. Style longer than nutlets. Mature nutlets dark brown, semiglobose-tetrahedral, ca. 1.3 mm, sparsely spinescent-tuberculate, adaxial bottom surface smaller, 2 lateral surfaces subequal in size; abaxial surfaces convex, becoming ovate, obtuse ribbed at margin, sessile; attachment scar at juncture of 3 ribs adaxially.

• Shaded moist rocky hills. Guangdong (Nan'ao Xian).

**13. *Trigonotis heliotropifolia*** Handel-Mazzetti, Anz. Akad. Wiss. Wien Math.-Nat. 66: 165. 1924.

毛花附地菜 *mao hua fu di cai*

*Trigonotis chuxiongensis* H. Chuang.

Herbs perennial, densely strigose. Rhizome crowns covered by persistent petioles. Stems erect to ascending, not branched or branched above, 20–50 cm tall. Basal leaves and lower stem leaves withered at anthesis; petiole 3–20 mm; stem leaves ovate to elliptic, 2–6 × 1–3 cm, abaxially sparsely short strigose, adaxially densely strigose, with sunken veins, base rounded, apex acute; lateral veins 4–7 pairs, 2 or 3 originating from base. Inflorescences terminal, to 10 cm, ebracteate or with 1–3 leaflike bracts below. Pedicel subdivaricate in fruit, 3–5 mm. Calyx funnellform, parted to middle; lobes lanceolate, ca. 3 mm, apex acuminate. Corolla blue; tube ca. 2 mm; throat appendages ca. 1 mm, short hairy, apex retuse; limb 5–7 mm wide; lobes horizontal, obovate, ca. 2 mm, appressed puberulent outside. Stamens reaching corolla throat; anthers elliptic, ca. 0.5 mm, apex obtuse. Mature nutlets dark brown, semiglobose-tetrahedral, dorsiventrally compressed, ca. 1 mm, glabrous, smooth, shiny, adaxial lateral surfaces subequal in size, longitudinally ribbed at juncture, abaxial surfaces extremely convex, narrowly ribbed at margin, apex acute; stipe present.

• Hillside meadows, forest margins, stream banks; 1500–3000 m. Sichuan (Muli Xian), Yunnan.

**14. *Trigonotis cavaleriei*** (H. Léveillé) Handel-Mazzetti, Symb. Sin. 7: 819. 1936.

西南附地菜 *xi nan fu di cai*

Herbs perennial. Rhizomes with many fibrous roots. Stems erect, usually not branched, slightly flexuous-curved, 20–50 cm tall, hirsute. Basal leaves withered after anthesis; petiole persistent, 3–10 cm, densely hirsute, base expanded, becoming sheath-shaped; leaf blade broadly ovate to elliptic, 3–10 × 1.5–5.5 cm, strigose, hairs discoid at base, abaxially with prominent midvein and obscure lateral veins, base cuneate to subcordate, margin ciliate, apex acute to acuminate; upper stem leaves short petiolate, smaller, usually narrowly ovate. Inflorescences terminal or axillary in upper stems, to 23 cm in fruit, ebracteate; peduncle long, usually dichotomously branched, strigose. Pedicel vertical, 3–4 mm. Calyx lobes broadly ovate, ca. 2 mm, densely short strigose on lower part, margin finely ciliate, apex obtuse; longitudinal veins prominent. Corolla blue or white; tube ca. 2 mm; throat appendages ca. 1 mm, short hairy, apex retuse; limb ca. 6 mm wide; lobes suborbicular, ca. 3 mm wide. Anthers oblong, ca. 1 mm, reaching throat. Mature nutlets dark brown, inverted subulate, trigonous-tetrahedral, ca. 1 mm, glabrous, shiny, adaxial 3 surfaces subequal in size; abaxial surfaces flat, acutely 3-ribbed, sessile. Fl. and fr. May–Aug.

• Forests, forest margins, moist areas, roadsides; 700–2000 m. Guizhou, Hunan, Sichuan, Yunnan.

- 1a. Leaf blade broadly ovate to elliptic, 3–10 × 2–5.5 cm, base rounded to subcordate, apex acute ..... 14a. var. *cavaleriei*  
1b. Leaf blade lanceolate, 4.5–8 × 1.5–3 cm, base cuneate, apex acuminate ..... 14b. var. *angustifolia*

**14a. *Trigonotis cavaleriei* var. *cavaleriei***

西南附地菜 (原变种) *xi nan fu di cai (yuan bian zhong)*

*Omphalodes cavaleriei* H. Léveillé, Repert. Spec. Nov. Regni Veg. 12: 188. 1913; *O. esquirolii* H. Léveillé; *O. vaniotii* H. Léveillé; *Trigonotis faberi* Handel-Mazzetti.

Leaf blade broadly ovate to elliptic, 3–10 × 2–5.5 cm, base rounded to subcordate, apex acute.

• Forests, forest margins, moist valley areas, roadsides; 700–2000 m. Guizhou, Sichuan, Yunnan.

**14b. *Trigonotis cavaleriei* var. *angustifolia*** C. J. Wang, Acta Bot. Yunnan, Suppl. 4: 39. 1982.

窄叶西南附地菜 *zhai ye xi nan fu di cai*

Leaf blade lanceolate, 4.5–8 × 1.5–3 cm, base cuneate, apex acuminate.

• Forests, forest margins, shaded moist areas. Hunan, Sichuan, C Yunnan.

**15. *Trigonotis leyeensis*** W. T. Wang, Acta Phytotax. Sin. 31: 65. 1993.

乐叶附地菜 *yue ye fu di cai*

Herbs perennial. Stems erect, branched, ca. 55 cm tall, spreading hispidulous. Basal leaves solitary; petioles long; basal leaf blades narrowly ovate, ca. 4.8 × 2.5 cm, papery, strigose, base truncate-rounded, margin entire, apex truncate-obtuse, apiculate; veins 3, inconspicuous. Cauline leaves short petiolate, oblong, gradually reduced upward, apex acute. Inflorescences terminal or axillary, 8–24 cm; rachis slender, sparsely strigulose, without bracts. Pedicel 0.8–2 mm, strigulose. Calyx campanulate, ca. 1.1 mm; lobes narrowly oblong, ca. 2 mm wide, outside strigulose, apex acute. Corolla deep blue, glabrous; tube ca. 0.8 mm; throat appendages crescent-shaped; limb ca. 1.6 mm in diam.; lobes ovate-quadrangular, ca. 0.7 mm. Anthers oblong, ca. 0.25 mm; filaments subequal. Pistil included, ca. 0.7 mm. Nutlets black, inverted subulate trigonous-tetrahedral, ca. 1 mm, glabrous, shiny, acute ribbed.

• Margins of evergreen forests; ca. 1000 m. Guangxi.

**16. *Trigonotis omeiensis*** Matsuda, Bot. Mag. (Tokyo) 33: 148. 1919.

峨眉附地菜 e mei fu di cai

Herbs perennial, rhizomatous. Stems not branched, 16–35 cm tall, short strigose; sterile branches to 75 cm, with few leaves. Basal leaves 2 or 3; petiole ca. 6 cm, base expanded becoming sheathlike; leaf blade elliptic to rotund, 3–8 × 2–6 cm, subleathery, sparsely strigose, base rounded, margin ciliate, apex rounded to obtuse, mucronate; veins conspicuous, lateral veins 5–7 pairs; stem leaves 2–5 at stem apex, nearly whorled, smaller. Inflorescences terminal, ebracteate; peduncle branched, ca. 8 cm, to 11 cm in fruit, strigose. Pedicel ca. 1 mm in fruit, densely strigose. Calyx lobed nearly to middle, with 5 slightly raised veins; lobes triangular-ovate, ca. 2 mm, slightly enlarged after anthesis, finely ciliate. Corolla blue-purple; tube ca. 2 mm; throat appendages ca. 0.3 mm; limb 4–5 mm wide; lobes suborbicular, ca. 2 mm wide. Anthers elliptic, ca. 0.3 mm, reaching throat, apex obtuse. Style extending 1–1.5 mm above nutlets. Mature nutlets dark brown, inverted subulate, trigonous-tetrahedral, 1–1.2 mm, glabrous, shiny, adaxial 3 surfaces subequal in size; abaxial surfaces flat, triangular, obtusely 3-ribbed, subsessile. Fl. and fr. May-Jul.

• Forests, thickets, shaded moist stream banks and ravines; 1000–1500 m. Sichuan.

**17. *Trigonotis formosana*** Hayata, J. Coll. Sci. Imp. Univ. Tokyo 25(19): 171. 1908.

台湾附地菜 tai wan fu di cai

Herbs perennial, runners usually floriferous. Stems not branched, 10–20 cm tall, usually strigose. Basal leaves long elliptic to lanceolate, 2–5 cm, base narrowly cuneate and decurrent to petiole, apex rounded, mucronate; stem leaves short petiolate, shorter, wider than basal leaves. Inflorescences (1 or) 2 or 3(–5), terminating branches, 5–15 cm, many flowered, ebracteate. Pedicel erect, 1–3 mm. Flowers crowded. Calyx lobes ovate-triangular, 0.5–1.5 mm, apex ± acute. Corolla tube ca. 1 mm; limb 2–3 mm wide; lobes broadly elliptic, 1–1.5 mm. Stamens inserted at middle of corolla; anthers ca. 0.3 mm. Mature nutlets black, inverted subulate, trigonous-tetrahedral, ca. 1 mm, shiny, adaxial 3

surfaces subequal in size; abaxial surfaces triangular, flat, glabrous, sometimes with 1–3 bristles near inside corner, sessile.  $2n = 48^*$ .

• Mountains. Taiwan.

**18. *Trigonotis elevatovenosa*** Hayata, Icon. Pl. Formosan. 6: 32. 1916.

凸脉附地菜 tu mai fu di cai

Herbs perennial, with thin runners, 15–20 cm tall. Stems erect, not branched, 10–20 cm tall, spreading hispid and strigose at base. Petiole of basal leaves long, 3–4 cm, red-brown hirsute; leaf blade elliptic, 2–2.5 × 1–1.3 cm, with 4 or 5 pairs of lateral veins, abaxially pallid, appressed pubescent, adaxially green, convex, base obtuse, margin entire or crispate, apex rounded, ± emarginate, mucronate; stem leaves of runners short petiolate, smaller, orbicular, ca. 8 mm. Inflorescences erect, racemelike, dichotomously branched or single, long, ca. 8 cm, thin; bracts absent. Pedicel erect, 1–3 mm. Calyx lobes obovate-spatulate, ca. 1.5 mm, apex obtuse. Corolla white; tube ca. 1.5 mm; limb 4–5 mm wide; lobes ovate, 1.5–2 mm. Stamens inserted on upper 2/3 of corolla tube; anthers elliptic, 0.5–0.7 mm. Mature nutlets black-brown, inverted subulate, trigonous-tetrahedral, 0.8–1 mm, glabrous, shiny, adaxial 3 surfaces subequal in size; abaxial surfaces triangular, acutely 3-ribbed, sessile.

• Mountains. N Taiwan.

**19. *Trigonotis nankotaizanensis*** (Sasaki) Masamune & Ohwi, Trans. Nat. Hist. Soc. Taiwan 23: 210. 1933.

白花附地菜 bai hua fu di cai

*Myosotis nankotaizanensis* Sasaki, Trans. Nat. Hist. Soc. Taiwan 21: 155. 1931; *Omphalodes formosana* Masamune.

Herbs perennial, caespitose, strigose, with obliquely spreading rhizomes. Stems erect, 10–15 cm. Basal leaves petiolate; upper stem leaves sessile; leaf blade oblanceolate to long elliptic, 7–15 cm, base attenuate, apex obtuse to ± acute. Inflorescences 1 or 2, terminal, racemose, 3–7 cm, 7–15-flowered; ebracteate or only upper part with 1 or 2 bracts. Pedicel erect, 3–7 mm. Flowers widely spaced. Calyx lobes lanceolate, 2–4 mm, apex acute. Corolla white; tube ca. 2 mm; limb 5–6 mm wide; lobes obovate, ca. 2 mm. Stamens inserted on upper 2/3 of corolla tube; anthers long elliptic, ca. 3 mm, apex obtuse. Nutlets brown, subulate, trigonous-tetrahedral, ca. 1.5 mm, smooth.

• E Taiwan (Nanhu Dashan).

**20. *Trigonotis girdalii*** Brand, Repert. Spec. Nov. Regni Veg. 26: 171. 1929.

秦岭附地菜 qin ling fu di cai

Herbs perennial. Stems erect, not branched, 30–50 cm tall, longitudinally ribbed, sparsely short strigose. Lower stem leaves mostly withered at anthesis, small; middle and upper stem leaves ± sessile, lanceolate, 2.5–6 cm × 5–12 mm,

abaxially finely short strigose, base narrowly cuneate, decurrent, apex acuminate; midvein prominent. Inflorescences dichotomously branched, 4–5 cm, to 6–7 cm in fruit, densely strigose, ebracteate. Pedicel 5–6 mm in fruit. Calyx 5-lobed; lobes oblong-obovate, ca. 2 mm, 1 frequently black orbicular spotted, short strigose, apex rounded. Corolla blue-purple; tube ca. 1.5 mm; throat appendages lunate, pubescent, ca. 0.6 mm, apex emarginate; limb ca. 5 mm wide; lobes divaricate, oblong, ca. 2.8 × 2 mm. Anthers elliptic, ca. 0.7 mm, exerted to throat. Nutlets dark brown, inverted subulate, trigonous-tetrahedral, ca. 1 mm, glabrous, adaxial 3 surfaces subequal in size; abaxial surfaces convex, triangular, acutely 3-ribbed, sessile. Fl. and fr. May-Jul.

• Thickets, forest margins, hillside meadows; 2400–2900 m. Shaanxi.

**21. *Trigonotis floribunda*** I. M. Johnston, J. Arnold Arbor. 33: 70. 1952.

多花附地菜 duo hua fu di cai

Herbs perennial, with long thin rhizomes. Stems erect to spreading; branches widely spaced at apex, 20–45 cm tall, sparsely short strigose. Petiole 3–12 mm; leaf blade elliptic or ovate-lanceolate, 2–5 × 1–2 cm, abaxially finely strigose, base cuneate, decurrent to petiole, apex acute to rounded; midvein conspicuous, lateral veins obscure; uppermost stem leaves short petiolate, smaller. Inflorescences terminal or axillary on upper stems, ebracteate; peduncle ca. 4 cm, to 11 cm in fruit, strigose. Pedicel ca. as long as calyx. Calyx lobes narrowly oblong, ca. 1.5 mm, to 2–3 mm in fruit; tube somewhat inflated, becoming cupular, pallid outside. Corolla blue-purple; tube ca. 1 mm; limb 2–2.5 mm wide; lobes suborbicular, 0.8–1 mm. Stamens inserted slightly above middle of corolla tube; anthers ca. 0.5 mm, connectives mucronate at apex. Mature nutlets dark brown, inverted subulate, trigonous-tetrahedral, cross-shaped, ca. 1 mm, glabrous, shiny, adaxial 3 surfaces subequal in size; abaxial surfaces triangular, flat or slightly concave, margin narrowly ribbed, angles curved upward, with an erect bristle at inside angle near style, sessile. Fl. Apr-Jun, fr. Jun-Jul.

• Forest margins, thickets, meadows, shaded moist stream banks and ravines; 600–1400 m. Sichuan.

**22. *Trigonotis laxa*** I. M. Johnston, J. Arnold Arbor. 33: 71. 1952.

南川附地菜 nan chuan fu di cai

Herbs perennial, with thin rhizomes. Stems erect to obliquely spreading, to 45 cm tall, sparsely short strigose; branches few and widely spaced or not branched. Petiole 0.3–7 cm; leaf blade elliptic to broadly lanceolate, 2.5–8 × 1–3.5 cm, abaxially sparsely short strigose, adaxially sparsely short strigose near apex, base rounded, decurrent into a narrowly winged petiole, apex rounded to obtuse, mucronate; midvein prominent, lateral veins obscure. Inflorescences terminal or from upper leaf axils, to 10 cm in fruit, sparsely short strigose, ebracteate. Pedicel 3–4 mm. Calyx lobes obovate, ca. 2 mm, slightly enlarged in fruit, short strigose, apex obtuse. Corolla light blue; tube ca. 1.5 mm, apex slightly expanded, ca. 2 mm wide; throat appendages ca. 0.5 mm, apex retuse; limb 4–5 mm wide; lobes suborbicular, ca. 2 mm wide.

Stamens inserted at middle of corolla tube; anthers ca. 0.4 mm. Mature nutlets brown, inverted subulate, trigonous-tetrahedral, ca. 1 mm, together fastigiata, glabrous, shiny, adaxial 3 surfaces subequal in size; abaxial surfaces triangular-ovate, narrowly 3-winged on ribs, apex acute, sessile. Fl. May-Jun, fr. Jun-Jul.

• Forest, forest margins, thickets, ravines, stream banks, mountain roadsides and valleys; 500–1600 m. Guizhou, Hunan, Jiangxi, Sichuan, Yunnan.

1a. Basal leaves ca. 8 × 3.5 cm, petiole to 7 cm ..... 22c. var. *xichougensis*

1b. Basal leaves 2.5–5 × 1–2.5 cm, petiole 0.3–2.5 cm.

2a. Stems sparsely short strigose; nutlets glabrous ..... 22a. var. *laxa*

2b. Stems spreading hirsute; nutlets sometimes sparsely pubescent ..... 22b. var. *hirsuta*

**22a. *Trigonotis laxa* var. *laxa***

南川附地菜 (原变种) nan chuan fu di cai (yuan bian zhong)

Stems sparsely short strigose. Petiole 0.3–2.5 cm; leaf blade 2.5–5 × 1–2.5 cm. Nutlets glabrous.

• Forest margins, thickets, shaded moist stream banks and ravines; 1500–1600 m. Sichuan (Nanchuan Xian).

**22b. *Trigonotis laxa* var. *hirsuta*** W. T. Wang ex C. J. Wang, Acta Bot. Yunnan 4: 39. 1982.

硬毛南川附地菜 ying mao nan chuan fu di cai

Stems and petioles spreading hirsute, hairs 0.5–1(–1.5) mm. Petiole 0.3–2.5 cm; leaf blade 2.5–5 × 1–2.5 cm. Nutlets sometimes sparsely pubescent.

• Thickets, forests, forest margins, streamsides and mountain roadsides; 500–1600 m. Guizhou, Hunan, Jiangxi.

**22c. *Trigonotis laxa* var. *xichougensis*** (H. Chuang) C. J. Wang, Kung & W. T. Wang, Fl. Reipubl. Popularis Sin. 64(2): 97. 1989.

西畴南川附地菜 xi chou nan chuan fu di cai

*Trigonotis xichougensis* H. Chuang, Acta Bot. Yunnan. 5: 61. 1983.

Stems sparsely short strigose. Petiole to 7 cm; basal leaves to 8 × 3.5 cm. Nutlets glabrous.

• Moist alpine ravines and valleys; ca. 1600 m. SE Yunnan (Xichou Xian).

**23. *Trigonotis bracteata*** C. J. Wang, Acta Phytotax. Sin. 18: 254. 1980.

全苞附地菜 quan bao fu di cai

Herbs perennial. Stems erect to obliquely spreading, 35–45 cm tall, short strigose. Leaf blade oblong to ovate, 1.5–4 × 0.5–1.5 cm, strigose, abaxially more densely and longer strigose along veins, base rounded to broadly cuneate, apex acute. Inflorescences at apex of branches, extra-axillary, with

solitary flowers, bracteate throughout; peduncle thin, weak, with thick hairs 1–1.5 cm; bracts leaflike. Pedicel 1–1.5 mm, densely short strigose, usually pendulous after anthesis. Calyx 5-parted; lobes narrowly ovate, ca. 2 mm, slightly enlarged in fruit, ca. 3 mm. Corolla light blue-purple; throat appendages ca. 0.5 mm, pubescent, apex retuse; limb 4–5 mm wide; lobes suborbicular, ca. 3 mm wide. Anthers oblong, ca. 0.5 mm, apex obtuse. Style slightly longer than corolla tube; stigma capitate. Nutlets brown, oblique subulate, trigonous-tetrahedral, ca. 1 mm, glabrous, adaxial bottom surface smaller than 2 subequal lateral surfaces; abaxial surfaces broadly ovate, 1–1.3 mm, narrowly marginate; stipe ca. 3 mm, curved. Fl. May.

• Forest margins, hillside meadows; ca. 2100 m. Xizang (Tongmai Xian).

**24. *Trigonotis radicans*** (Turczaninow) Steven subsp. ***sericea*** (Maximowicz) Riedl, Linzer Biol. Beitr. 25: 94. 1993.

北附地菜 bei fu di cai

*Omphalodes sericea* Maximowicz, Bull. Acad. Imp. Sci. Saint-Petersbourg 17: 453. 1872; *O. aquatica* Brand; *O. aquatica* var. *sinica* Brand; *O. sericea* var. *koreana* Brand; *Trigonotis coreana* Nakai; *T. nakaii* H. Hara; *T. radicans* var. *sericea* (Maximowicz) H. Hara; *T. sericea* (Maximowicz) I. M. Johnston; *T. sericea* Ohwi.

Herbs perennial, sparsely short strigose, glabrescent, or more densely sericeous-strigose. Stems several, cespitose, erect becoming creeping, to 50 cm tall, rooting from apex or producing rooting branches from axils of upper leaves. Petiole of basal leaves to 18 cm; leaf blade oblong-ovate to ovate, 1–4 cm, rarely longer, abaxially finely short strigose, base cordate to rounded, apex acute; midvein prominent, lateral veins obscure; stem leaves short petiolate. Pedicel to 2 cm in fruit, densely short strigose. Flowers solitary, above stem leaf axils. Calyx 5-parted; lobes lanceolate to broadly ovate, ca. 3 mm, to 5 mm in fruit, apex acute. Corolla light blue or white; tube ca. 1.2–2 mm; throat appendages ca. 0.5 mm, pubescent; limb 6–8(–12) mm wide; lobes divaricate, oblong. Anthers elliptic, ca. 0.5 mm, apex obtuse. Mature nutlets brown, oblique subulate, trigonous-tetrahedral, pubescent, adaxial bottom surface slightly smaller than 2 lateral surfaces; abaxial surfaces flat, rhomboid to rhomboid-ovate, ca. 2 mm, margin narrowly ribbed, apex acute; stipe ca. 0.8 mm, curved. Fl. Jun–Aug, fr. Jul–Sep.

Forest margins, thickets, brookside meadows. NE Hebei, Heilongjiang, Jilin, Liaoning [Japan, Korea, Russia].

**25. *Trigonotis myosotidea*** (Maximowicz) Maximowicz, Bull. Acad. Imp. Sci. Saint-Petersbourg 27: 506. 1881.

水甸附地菜 shui dian fu di cai

*Eritrichium myosotideum* Maximowicz, Prim. Fl. Amur. 203. 1859.

Plants perennial. Rhizomes creeping, black. Stem usually single or few, erect, 20–45 cm tall, sparsely short strigose, branched at apex; stem leaves oblong-lanceolate to lanceolate, 2.5–6 cm × 7–10 mm, sparsely short strigose or glabrescent, base narrowly cuneate, decurrent on a short narrowly winged

petiole, apex acute. Inflorescences terminal on stems and branches, to 15 cm in fruit, reclinate, bracteate only at base. Pedicel ca. 5 mm, to 1 cm in fruit, recurved, rarely horizontal. Calyx lobes narrowly elliptic, ca. 1.5 mm, to 4–5 mm in fruit, sparsely short strigose, apex acute. Corolla light blue; tube ca. 1.8 mm; throat appendages short hairy, apex retuse; limb ca. 6 mm wide; lobes divaricate, broadly ovate, ca. 2.5 mm. Anthers elliptic, ca. 0.6 mm, base subcordate, apex obtuse. Nutlets dark brown, oblique subulate, trigonous-tetrahedral, shiny, glabrous, sessile, adaxial bottom surface smaller than 2 subequal lateral surfaces, margin narrowly ribbed, apex acute; abaxial surfaces flat or slightly concave, triangular, ca. 2 mm. Fl. and fr. Jul–Aug.

In tussocks in swamps, moist ditch banks. Hebei, Heilongjiang, Jilin, Liaoning [E Russia].

**26. *Trigonotis tenera*** I. M. Johnston, J. Arnold Arbor. 21: 56. 1940.

蒙山附地菜 meng shan fu di cai

Herbs perennial, densely cespitose, with short thick caudex and withered petioles. Stems numerous, cespitose, prostrate to ascending, 10–16 cm tall, sparsely strigose. Basal leaves numerous; petiole 0.3–1.8 cm, base expanded becoming sheathy, ciliate; leaf blade cordate to orbicular-ovate, 0.5–3 × 0.5–1.5 cm, finely strigose, base cordate, rarely rounded, apex acute; upper and middle stem leaves few, with smaller blade and petiole 4–5 mm. Inflorescences terminal, 5–9 cm; bracts basal, 2 or 3, leaflike. Pedicel filiform, 0.8–2 cm. Calyx lobes lanceolate, 0.5–2 mm at anthesis, slightly enlarged in fruit, apex acute. Corolla blue; tube ca. 1.5 mm; throat appendages ca. 0.5 mm; limb ca. 3 mm wide; lobes divaricate, suborbicular, ca. 1.5 mm. Stamens inserted on middle of corolla tube; anthers oblong, ca. 0.5 mm. Nutlets dark brown, oblique subulate, trigonous-tetrahedral, vertical, 1–3 mm, sparsely pubescent, adaxial 3 surfaces slightly convex, bottom surface smaller than 2 subequal lateral surfaces, longitudinally ribbed at juncture of lateral surfaces; abaxial surfaces convex or somewhat flat, ovate, acutely 3-ribbed, apex acute; stipe ca. 0.3 mm, straight to ± curved. Fl. Aug.

• Moist forests, forest margins, crevices; ca. 900 m. Shandong.

**27. *Trigonotis petiolaris*** Maximowicz, Bull. Acad. Imp. Sci. Saint-Petersbourg 27: 506. 1881.

祁连山附地菜 qi lian shan fu di cai

Herbs perennial, densely cespitose, with short thick caudex. Stems numerous, cespitose, erect to ascending, 15–20 cm tall, sparsely fine strigose. Petiole of basal leaves 2–4 cm, sparsely strigose; leaf blade oblong to rotund, unequal in size, 0.7–4 × 0.7–1.5 cm, sparsely strigose, base rounded to subcordate, rarely broadly cuneate, apex rounded, mucronate. Upper stem leaves short petiolate, elliptic. Inflorescences terminal; bracts 2 or 3, basal, leaflike. Pedicel spreading or subhorizontal, filiform, 1–2.5 cm. Calyx lobes ovate, 1.5–2

mm, apex acute. Corolla light blue; tube ca. 1 × 1.5 mm; throat appendages ca. 0.5 mm; limb ca. 3 mm wide; lobes suborbicular. Nutlets dark brown, oblique subulate, trigonous-tetrahedral, pubescent, adaxial bottom surface slightly convex, 2 lateral surfaces flat, at their juncture 1 longitudinally ribbed; abaxial surfaces convex, triangular-ovate, ca. 1.5 mm, acutely 3-ribbed, apex acute; stipe short, curved.

• Hillside meadows, roadsides; 2700–2900 m. Gansu (E Qilian Shan), Qinghai.

**28. *Trigonotis harrismithii*** R. R. Mill in & G. L. Chu, Kamelin, R. R. Mill, & M. G. Gilbert, Novon 5: 17. 1995.

松潘附地菜 song pan fu di cai

*Trigonotis smithii* W. T. Wang, Bull. Bot. Res., Harbin 13(1): 3. 1993, not Banerjee, Bull. Bot. Surv. India 8: 325. 1967.

Stems 4 to many, caespitose, simple or with a single lateral branch, slender, 5–19 cm tall, sparsely minute strigose. Petiole 0.9–1.2 cm, shorter in upper leaves; leaf blade ovate to narrowly elliptic, 6–13 × 3–8 mm, papery, densely appressed puberulent, base broadly cuneate, apex acute; lateral veins prominent abaxially, flat adaxially. Inflorescences 3.2–12 cm, 5–15-flowered; bracts basal or throughout, sessile or short stalked, narrowly ovate to narrowly elliptic; axis and pedicel densely puberulent. Pedicel 0.6–3 mm, lowermost often longer. Calyx lobes ca. 1 mm at anthesis, ca. 2 mm in fruit, densely appressed puberulent on both sides, apex acute. Corolla blue, glabrous; tube 0.8–1 mm; appendages lunate; limb 1.7–2.2 mm wide; lobes obovate-quadrate, rounded to truncate at apex. Anthers ovate, 0.3–0.4 mm. Nutlets subulate, trigonous-tetrahedral; adaxial surfaces triangular, ca. 1.2 × 0.6 mm, with prominent adaxial angle; abaxial surfaces convex, ovate-triangular, ca. 1.2 × 1 mm, finely puberulent; stipe short. Fl. and fr. Jul.

• Mountain meadows, along rivulets; ca. 3200 m. Sichuan.

**29. *Trigonotis longipes*** W. T. Wang, Bull. Bot. Res., Harbin 6(3): 85. 1986.

长梗附地菜 chang geng fu di cai

Plants ?biennial. Stems ascending, branched from the base upward, 8–20 cm tall, sparsely strigose. Petiole of basal and lower stem leaves 2–3.6 cm, sparsely minute strigose; leaf blade narrowly elliptic to elliptic-ovate, 1–2.2 cm × 6–9 mm, strigose, base cuneate, apex ± acute or subobtusate, often apiculate; lateral veins 3 pairs, inconspicuous; upper stem leaves and bracts gradually decreasing in size, short petiolate to sessile, narrowly ovate to spatulate. Inflorescences 1–17 cm, occupying whole length of branches, axis sparsely minute strigose. Pedicel 4–9 mm, 0.9–1.6 cm in fruit, densely minute strigose at apex. Calyx lobes narrowly triangular, ca. 1.8 mm, united at base, minutely strigose. Corolla purple, glabrous, 4–5 mm wide; tube ca. 1.1 mm; appendages low trapeziform, ca. 0.3 mm; lobes suborbicular. Anthers oblong, ca. 0.5 mm. Nutlets subulate, trigonous-tetrahedral, smooth, sparsely

pubescent; abaxial surfaces plane, deltate-ovate, ca. 1.2 × 1.2 mm, with sharp angles, sessile. Fl. and fr. Jun.

• Along paths and rivulets; 3200–3500 m. Sichuan.

**30. *Trigonotis gracilipes*** I. M. Johnston, J. Arnold Arbor. 18: 9. 1937.

细梗附地菜 xi geng fu di cai

Herbs perennial. Stems usually numerous, caespitose, erect to ascending, branched below or not, 10–40 cm tall,



strigose. Leaves numerous; petiole 1–4 cm; leaf blade elliptic to oblong-lanceolate, 0.7–3 cm × 3–15 mm, abaxially strigose, base narrowly cuneate to rounded, apex rounded, mucronate; upper stem leaves short petiolate or sessile. Inflorescences of middle and lower stems and branches extra-axillary, 1-flowered, bracteate and several flowered on stem apices. Pedicel 1–10 mm, to 2 cm in fruit, straight and obliquely spreading, or tortuous. Calyx lobes ovate, ca. 1.5 mm, slightly enlarged to 2–3 mm, strigose, apex acute. Corolla light blue; tube ca. 2 × 2 mm; limb 4–5 mm wide; lobes suborbicular. Anthers oblong, apex obtuse. Mature nutlets dark brown, oblique subulate, trigonous-tetrahedral, sparsely pubescent, adaxial bottom surface slightly convex, smaller, 2 lateral surfaces equal in size, slightly concave; abaxial surfaces flat, triangular-ovate, ca. 1.3 mm, narrowly 3-ribbed; carpophore ca. 0.2 mm, sharply recurved. Fl. Jun-Jul, fr. Jul-Aug.

• Hillside meadows, forests, forest margins, valleys, ravines; 2500–4200 m. SW Sichuan, S Xizang, NW Yunnan.

*Trigonotis gracilipes* resembles *T. ovalifolia* of the Himalaya and India except for the bracteate inflorescences. It resembles *T. delicatula* and *T. corispermoides* in having the inflorescences of lower and middle stems with solitary extra-axillary flowers, but the nutlets in these two species are semiglobose-tetrahedral.

**31. *Trigonotis muliensis*** W. T. Wang, Bull. Bot. Res., Harbin 6(3): 84. 1986.

木里附地菜 mu li fu di cai

Plants ?perennial. Stems branched from the base upward or only at apex, 23–28 cm tall, spreading white pubescent. Petiole of upper stem leaves 3–14 mm, longer in basal leaves; leaf blade broadly ovate to broadly elliptic, 1–1.8 × 0.9–1.2 cm, appressed pubescent, apex obtuse or rounded, apiculate; lateral veins indistinct. Inflorescences 1.5–11 cm, few to many flowered, axis with spreading hairs at base, minutely strigose at apex. Pedicel 1.5–4.5 mm, to 7 mm in fruit, minutely strigose. Calyx lobes oblong-ovate, ca. 3 mm, strigose, with long white hairs at margin, slightly connected at base. Corolla blue, ca. 4.5 mm wide; tube ca. 1.1 mm; appendages low trapeziform, ca. 0.4 mm; lobes 5, suborbicular. Anthers oblong, ca. 0.5 mm. Nutlets subulate, trigonous-tetrahedral, smooth, with very short hairs; abaxial surfaces deltate-ovate, ca. 1.2 × 1.2 mm, inner surfaces subequal in size, joined at sharp angles; stipe indistinct. Fl. and fr. Jul.

• Mountain slopes; above 3000 m. Sichuan.

**32. *Trigonotis microcarpa*** (de Candolle) Benth. ex C. B. Clarke in J. D. Hooker, Fl. Brit. India 4: 172. 1883.

毛脉附地菜 mao mai fu di cai

*Eritrichium microcarpum* de Candolle in A. de Candolle, Prodr. 10: 123. 1846; *Myosotis microcarpa* Wallich; *Trigonotis peduncularis* (Treviranus) Benth. ex Baker & Moore var. *microcarpa* (de Candolle) Brand.

Herbs perennial, with short rhizomes and caudex and persistent petioles. Stems erect to ascending, 20–60 cm tall, short strigose; branches numerous, short. Petiole of basal and

lower stem leaves to 3 cm; leaf blade ovate to oblong, 1.5–5 × 0.5–2 cm, abaxially strigose, with more numerous longer hairs along prominent veins, base rounded, apex mucronate; lateral veins 3 pairs, basal pair arcuate. Inflorescences 2–4 cm, to 18 cm in fruit, short strigose; bracts at base only. Pedicel 3–5 mm in fruit. Calyx lobes lanceolate, 2–2.5 mm, apex acute. Corolla blue-purple; tube ca. 2 mm; throat appendages retuse at apex; limb 4–5 mm wide; lobes divaricate, broadly ovate. Anthers elliptic, ca. 0.6 mm, apex mucronulate. Nutlets dark brown, oblique subulate, trigonous-tetrahedral, 0.8–1 mm, smooth, glabrous, adaxial bottom surface slightly convex, somewhat smaller than 2 equal lateral surfaces; abaxial surfaces convex, ovate, acutely 3-ribbed; carpophore obscure, short.

Hillside meadows, thickets, forest margins, stream banks, valleys; 1000–2800 m. Guangxi, SW Guizhou, S and SE Xizang, NW, SE and W Yunnan [Bhutan, India, Japan, Kazakhstan, Nepal, Russia].

**33. *Trigonotis longiramosa*** W. T. Wang, Bull. Bot. Res., Harbin 6(3): 83. 1986.

长枝附地菜 chang zhi fu di cai

Plants ?perennial. Stems diffuse, with long branches from base upward, ca. 60 cm tall, minutely crisped strigose. Basal leaves unknown. Lower stem leaves long petiolate; leaf blade ca. 5.8 × 2 cm, pubescent, base broadly truncate, apex obtuse, short apiculate; lateral veins 2 pairs, indistinct; upper leaves reduced in size upward, narrowly ovate, 1.5–4 cm, apex acute. Inflorescences 12–50 cm in fruit, minutely strigose; bracts in lower part, leaflike. Pedicel 1.5–6 mm, minutely strigose. Calyx lobes linear-lanceolate, ca. 1.2 mm, sparsely pubescent, margin long ciliate. Corolla glabrous; tube ca. 1.5 mm; faucal appendages low trapeziform, ca. 0.4 mm; limb ca. 5 mm wide; lobes orbicular-obovate. Anthers oblong, ca. 0.5 mm. Pistil ca. 1 mm. Nutlets subulate, trigonous-tetrahedral, smooth, glabrous, adaxially with sharp angles; abaxial surfaces deltate-ovate, ca. 1 × 1 mm; stipe ca. 0.2 mm. Fl. and fr. Oct.

• Sichuan.

**34. *Trigonotis cinereifolia*** C. J. Wang, Acta Phytotax. Sin. 18(2): 254. 1980.

灰叶附地菜 hui ye fu di cai

Herbs perennial. Stems erect, much branched, rarely not branched, 30–45 cm tall, short strigose. Petiole of lower leaves to 3 cm; stem leaves gray, ovate to oblong, 0.7–2 cm × 3–10 mm, subleathery, abaxially densely strigose, with more numerous longer hairs along prominent veins, base broadly cuneate to rounded, apex obtuse, mucronate; middle and upper stem leaves short petiolate to sessile. Inflorescences terminal, densely strigose; lowermost 2–5 flowers with leaflike bracts. Pedicel spreading, 3–10 mm, densely strigose. Calyx lobes narrowly elliptic, ca. 3 mm in fruit, densely strigose, apex acuminate. Corolla light blue; tube ca. 1 mm; throat appendages ca. 0.5 mm, pubescent; limb 4–5 mm wide; lobes broadly obovate, ca. 2 mm. Anthers oblong, apex mucronate. Style ca. as long as corolla tube. Nutlets dark brown, oblique subulate, trigonous-tetrahedral,

ca. 1 mm, glabrous, shiny, adaxial bottom surface slightly smaller than 2 lateral surfaces; abaxial surfaces broadly ovate, acutely 3-ribbed; carpophore short, curved. Fl. Jun-Jul, fr. Jul-Aug.

- Thickets, meadows; ca. 2000 m. Xizang (Tongmai Xian).

**35. *Trigonotis rockii*** I. M. Johnston, Contr. Gray Herb. 75: 47. 1925.

高山附地菜 gao shan fu di cai

Herbs perennial, densely cespitose. Stems erect, base frequently ascending, 7–15 cm tall, sparsely strigose. Petiole of basal leaves 1–3 cm; leaf blade green, elliptic to ovate, ca. 2.5 × 1 cm, sparsely strigose, base rounded, apex obtuse, mucronate; stem leaves smaller, short petiolate to subsessile. Inflorescences racemose; bracts basal, leaflike. Pedicel 2–7 mm, usually spreading, strigose. Calyx lobes narrowly oblong to oblanceolate-oblong, ca. 2 mm, densely long strigose, apex obtuse. Corolla light blue-purple; tube ca. 2 mm; throat appendages trapeziform, ca. 0.8 mm, pubescent; limb 7–8 mm wide; lobes rotate spreading, suborbicular. Stamens inserted above middle of corolla tube; anthers elliptic. Style slightly longer than corolla tube. Nutlets subulate, irregularly trigonous-tetrahedral, ca. 2 × 2 mm, glabrous, obscurely tuberculate.

- Alpine valleys, hillside meadows, thickets; 3300–4900 m. S Xizang, NW Yunnan.

**36. *Trigonotis peduncularis*** (Trevisan) Benth. ex Baker & S. Moore, J. Linn. Soc., Bot. 17: 384. 1879.

附地菜 fu di cai

Herbs annual or biennial. Stems usually numerous, rarely single, crowded, diffuse, much branched at base, 5–30 cm tall, short strigose. Basal leaves rosulate, petiolate, spatulate, 2–5 cm, strigose, base cuneate to attenuate, apex rounded to obtuse; upper stem leaves sessile or short petiolate, oblong to elliptic. Inflorescences terminal, circinate when young, gradually elongated, 5–20 cm; basal 2 or 3 flowers with leaflike bracts. Pedicel to 3–5 mm after anthesis, apex thickened, clavate in fruit. Calyx lobes ovate, 1–3 mm, apex acute. Corolla light blue or pink; throat appendages white or yellowish; limb 1.5–2.5 mm; lobes divaricate, obovate, apex rounded to obtuse. Anthers ovate, ca. 0.3 mm, apex mucronate. Nutlets oblique subulate, trigonous-tetrahedral, 0.8–1 mm, short pubescent or glabrous, adaxial 2 lateral surfaces subequal, bottom surface smaller and convex; abaxial surfaces triangular-ovate, acutely 3-ribbed; carpophore ca. 1 mm, curved. Fl. early.

Hillsides, meadows, forest margins, thickets, fields, waste areas. Fujian, Gansu, N Guangxi, Hebei, Heilongjiang, Jiangxi, Jilin, Liaoning, Nei Mongol, Ningxia, Shaanxi, Shandong, Shanxi, Xinjiang, Xizang, Yunnan [temperate Asia, E Europe].

- 1a. Corolla 1.5–2(–3) mm wide, tube scarcely 1 mm ..... 36a. var. *peduncularis*  
1b. Corolla 3.5–5(–6) mm wide, tube

1.5–2 mm.

- 2a. Calyx lobes linear-lanceolate in fruit, apex acute ..... 36b. var. *macrantha*  
2b. Calyx lobes oblanceolate-linear in fruit, apex obtuse to rounded, rarely acute ..... 36c. var. *amblyosepala*

**36a. *Trigonotis peduncularis* var. *peduncularis***

附地菜(原变种) fu di cai (yuan bian zhong)

*Myosotis peduncularis* Trevisan, Ges. Naturf. Freunde Berlin Mag. Neuesten Entdeck. Gesamten Naturk. 7: 147. 1813; *Eritrichium pedunculare* (Trevisan) A. de Candolle; *E. japonicum* Miquel; *Myosotis chinensis* A. de Candolle; *Trigonotis clavata* Steven.

Corolla 1.5–2.5 mm wide; tube scarcely 1 mm wide. Calyx lobes narrowly triangular to linear-triangular in fruit.

Hillsides, meadows, forest margins, fields, waste areas. Fujian, Gansu, N Guangxi, Heilongjiang, Jiangxi, Jilin, Liaoning, Nei Mongol, Xinjiang, Xizang, Yunnan [temperate Asia, E Europe].

**36b. *Trigonotis peduncularis* var. *macrantha*** W. T. Wang, Bull. Bot. Res., Harbin 6(3): 89. 1986.

大花附地菜 da hua fu di cai

Corolla 3.5–4.5 mm wide; tube ca. 2 mm. Calyx lobes linear-lanceolate in fruit, apex acute.

- Gansu, Hebei, Nei Mongol, Ningxia, Shaanxi, Shandong, Shanxi.

**36c. *Trigonotis peduncularis* var. *amblyosepala*** (Nakai & Kitagawa) W. T. Wang, Bull. Bot. Res., Harbin 6(3): 90. 1986.

钝萼附地菜 dun e fu di cai

*Trigonotis amblyosepala* Nakai & Kitagawa, Rep. Exped. Manchoukuo, Sect. IV, 4(1): 44. 1934.

Corolla 3.5–5(–6) mm wide; tube ca. 1.5 mm. Calyx lobes oblanceolate-linear in fruit, apex obtuse or rounded, rarely ± acute.

- Hillside meadows, forest margins, thickets, fields. Hebei, Nei Mongol, Ningxia, Shaanxi, Shandong, Shanxi.

**37. *Trigonotis tibetica*** (C. B. Clarke) I. M. Johnston, Contr. Gray Herb. 75: 48. 1925.

西藏附地菜 xi zang fu di cai

*Eritrichium tibeticum* C. B. Clarke in J. D. Hooker, Fl. Brit. India 4: 165. 1883; *Pedinogyne tibetica* (C. B. Clarke) Brand.

Herbs annual or biennial, diffuse, 10–25 cm tall. Stems much branched, short strigose. Basal leaves and lower stem leaves petiolate, elliptic-ovate to linear, 0.8–2 cm × 2–6 mm, short gray strigose, base cuneate, apex acute. Inflorescences terminal, lax; bracts basal only, leaflike. Pedicel usually obliquely spreading, to 5 mm. Calyx 5-parted; lobes erect,

narrowly ovate to lanceolate, to 1.5 mm. Corolla light blue or white, campanulate; tube ca. 1.5 mm; throat yellow; appendages lunate; limb ca. 3 mm wide; lobes obovate, ca. 1.5 mm. Stamens included, inserted at middle of corolla tube. Nutlets dark brown, oblique subulate, trigonous-tetrahedral, 1–1.5 mm, shiny, usually glabrous, adaxial bottom surface prominent, 2 lateral surfaces equal, a longitudinal rib at their juncture; abaxial surface convex, ovate, acutely 3-ribbed; carpophore sharply curved. Fl. May-Sep, fr. Jun-Sep.

Alpine and subalpine hillside meadows, thickets. Qinghai, W Sichuan, Xizang [Bhutan, N India, Nepal].

**38. *Trigonotis leucantha*** W. T. Wang, Bull. Bot. Res., Harbin 6(3): 87. 1986.

白花附地菜 bai hua fu di cai

Herbs annual. Stems much branched from base upward, ca. 15 cm tall, white pubescent. Petiole of basal leaves 1.8–3.4 cm; leaf blade ovate, 0.9–1.6 cm × 6–12 mm, papery, minutely strigose, base rounded-truncate, apex rounded; stem leaves similar, with shorter petiole, sometimes ± cordate at base. Inflorescences 2–7 cm, axis minutely strigose; bracts basal, 2 or 3. Pedicel 1.5–3 mm, minutely strigose. Calyx lobes broadly lanceolate, ca. 1.2 mm, outside sparsely minute strigose, apex acute. Corolla white, glabrous, ca. 4 mm wide;

tube ca. 1 mm; throat appendages trapeziform, ca. 0.2 mm; lobes suborbicular. Anthers ca. 0.3 mm. Nutlets subulate, trigonous-tetrahedral, smooth, glabrous, adaxial surfaces forming sharp angles; abaxial surfaces deltate, ca. 1.1 × 1 mm, sessile. Fl. and fr. Jul.

• In mountain forests; ca. 3700 m. Sichuan.

**39. *Trigonotis funingensis*** H. Chuang, Acta Bot. Yunnan. 5: 62. 1983.

富宁附地菜 fu ning fu di cai

Herbs perennial. Rhizomes dark brown, ca. 6 mm in diam., usually ascending, frequently with withered petioles; roots numerous, fine, fibrous. Stems erect, usually not branched, 20–25 cm, strigose. Basal leaves 2 or 3; petiole 4–8 cm, leaf blade long elliptic to narrowly ovate, 7–20 × 3–4 cm, abaxially sparsely strigose, base rounded or slightly so, apex rounded, mucronate; stem leaves smaller, short petiolate. Inflorescences 2 or 3, fascicled on stem and branch apices, ebracteate. Pedicel ca. 3 mm, densely strigose. Calyx lobes oblanceolate, 2–3 mm, apex acute. Corolla white or light blue; limb ca. 5 mm wide; lobes obovate to orbicular, ca. 2.5 × 2 mm. Mature nutlets unknown.

• Forests; ca. 1000 m. Yunnan (Funing Xian).

## 21. SINOJOHNSTONIA H. H. Hu, Bull. Fan Mem. Inst. Biol. 7: 201. 1936.

车前紫草属 che qian zi cao shu

Herbs perennial, usually rhizomatous. Stems erect or prostrate. Leaves alternate. Basal leaves long petiolate, ovate-cordate; stem leaves smaller, short petiolate. Cymes terminal, racemose or paniculate. Calyx 5-parted to near base, enlarged, becoming saccate in fruit. Corolla tubular to funnelliform; throat appendages 5, shallowly 2-cleft; limb 5-parted, spreading. Stamens inserted above middle of corolla tube or at throat between appendages, exserted or included; filaments filiform. Ovary 4-divided. Style elongated; stigma capitate; ovules anatropous. Gynobase low fastigiate. Nutlets tetrahedral; margin abaxially exserted, becoming a cupular emergence; attachment scar slightly below middle adaxially.

Three species: endemic to China.

- 1a. Stamens included; corolla tube distinctly shorter than limb; nutlets pubescent; plants without rhizomes ..... 1. *S. moupinensis*  
 1b. Stamens slightly exserted; corolla tube ca. as long as to longer than limb; nutlets glabrous or sparsely pubescent; plants with rhizomes.  
 2a. Corolla lobes narrowly triangular, ca. as long as tube; stamens inserted on throat between appendages ..... 2. *S. plantaginea*  
 2b. Corolla lobes ovate, ca. 1/2 as long as tube; stamens inserted below throat appendages ..... 3. *S. chekiangensis*

**1. *Sinojohnstonia moupinensis*** (Franchet) W. T. Wang, Bull. Bot. Res., Harbin 4(2): 2. 1984.

短蕊车前紫草 duan rui che qian zi cao

*Omphalodes moupinensis* Franchet, Nouv. Arch. Mus. Hist. Nat., ser. 2, 10: 64. 1887; *O. cordata* Hemsley; *Trigonotis moupinense* (Franchet) I. M. Johnston.

Plants with fibrous roots, not rhizomatous. Stems several, 15–20 cm tall, short strigose. Basal leaves several; petiole 4–7 cm; leaf blade ovate-cordate, 4–10 × 2.5–6 cm, sparsely strigose, short appressed pubescent, apex short acuminate; stem leaves widely spaced, smaller, 1–2 cm. Inflorescences 1–1.5 cm, densely short appressed pubescent,

few flowered. Calyx 2.5–3 mm; lobes lanceolate, short appressed pubescent. Corolla white or purplish; tube shorter than calyx, ca. 1.6 mm; throat appendages semiorbicular, papillate; limb ca. 2 × as long as tube; lobes obovate. Stamens inserted slightly above middle of corolla, included; anthers oblong, ca. 0.6 mm. Style ca. 1.5 mm. Nutlets black-brown, ca. 2.5 mm, adaxially short pubescent; margin of cupular emergence light red-brown, glabrous, mouth constricted, ca. 1.5 mm. Fl. and fr. Mar-Jul.

• Forests, shaded moist rocky areas; 1000–2700 m. Gansu, Hubei, Hunan, Ningxia, Shaanxi, Shanxi, Sichuan, Yunnan.

**2. *Sinojohnstonia plantaginea*** H. H. Hu, Bull. Fan Mem.

Inst. Biol. 7: 203. 1936.

车前紫草 che qian zi cao

Plants with divaricate rhizomes, ca. 6 mm in diam. Stems several, 15–20 cm tall, short strigose. Basal leaves numerous; petiole 7–20 cm; leaf blade ovate-cordate, 6–13 × 3–10 cm, sparsely short strigose, apex short acuminate; stem leaves borne at apex, 1.5–3.5 cm. Inflorescences to 5 cm, densely short strigose, many flowered, ebracteate. Calyx ca. 3.5 mm, 5-parted to base; lobes ovate-lanceolate, abaxially short strigose. Corolla white, campanulate, slightly longer than calyx, ca. 4 mm; tube ca. 2.2 mm; throat appendages ca. 4 mm; lobes of limb narrowly triangular, slightly shorter than tube. Stamens inserted between appendages, exerted from corolla; filaments filiform, ca. 4 mm; anthers oblong, ca. 0.8 mm, apex obtuse. Style ca. 6 mm, exerted. Nutlets ca. 2.5 mm, glabrous, shiny; cupular emergence light yellow-brown, ca. 1 mm. Fl. and fr. Mar-Sep.

• Forests, shaded moist ravines. SE Gansu, Sichuan.

**3. Sinojohnstonia chekiangensis** (Migo) W. T. Wang, Bull. Bot. Res., Harbin 4(2): 3. 1984.

浙赣车前紫草 zhe gan che qian zi cao

*Omphalodes chekiangensis* Migo, Bot. Mag. (Tokyo) 56: 265. 1942.

Plants with several rhizomes, to 15 cm. Stems several, prostrate to spreading, 10–35 cm tall. Basal leaves several; petiole to 12 cm; leaf blade ovate, 7–12 × 3–6 cm, densely short strigose, base cordate, apex acuminate; stem leaves smaller. Inflorescences densely short strigose, many flowered, ebracteate. Calyx ca. 6 mm, 5-parted to base; lobes linear-lanceolate, densely strigose abaxially. Corolla white or light reddish, campanulate, ca. 1 cm, glabrous; tube shorter than calyx; throat appendages ca. 1 mm; limb ca. 1/2 as long as tube; lobes ovate. Stamens inserted on upper part of corolla tube, slightly exerted; filaments ca. 3 mm; anthers oblong, ca. 0.9 mm, apex obtuse. Style ca. 6 mm, exerted. Nutlets 3–5 mm; margin of cupular emergence inflexed. Fl. and fr. Apr-May.  $2n = 24^*$ .

• Forests, shaded moist rocky areas; ca. 900 m. Hunan, Jiangxi, Shaanxi, Shanxi, Zhejiang.

## 22. OMPHALOTRIGONOTIS W. T. Wang, Bull. Bot. Res., Harbin 4(2): 8. 1984.

皿果草属 min guo cao shu

Herbs annual. Stems erect, branched or not. Leaves alternate, petiolate, elliptic-ovate, strigose. Cymes ebracteate. Flowers short pedicellate. Calyx 5-parted to base; lobes subdivaricate, oblong, slightly enlarged in fruit. Corolla campanulate, glabrous; tube ca. as long as limb; throat with appendages. Stamens inserted slightly above middle of corolla tube, included; filaments extremely short. Ovary 4-parted. Style included. Gynobase flat. Nutlets tetrahedral; margin of abaxial surface exerted, becoming a cupular emergence; attachment scar at corner of 3 adaxial surfaces.

Two species: endemic in China.

- 1a. Cymes to 18 cm in fruit; corolla ca. 2.5 mm; petiole not membranous, cuneate at base ..... 1. *O. cupulifera*
- 1b. Cymes 2–3 cm in fruit; corolla ca. 6 mm; petiole membranous, sheathing at base ..... 2. *O. vaginata*

**1. Omphalotrigonotis cupulifera** (I. M. Johnston) W. T. Wang, Bull. Bot. Res., Harbin 4(2): 11. 1984.

皿果草 min guo cao

*Trigonotis cupulifera* I. M. Johnston, J. Arnold Arbor. 33: 69. 1952.

Stems usually single, erect to prostrate, rarely branched, 20–40 cm tall, sparsely short strigose. Petiole 0.5–4 cm; leaf blade elliptic-ovate to narrowly elliptic, 1.5–4 × 1–2.3 cm, short strigose, base broadly cuneate, apex obtuse, mucronate. Cymes to 18 cm in fruit. Pedicel 1–3.5 mm. Calyx lobes oblong, ca. 2 mm, to 3.5 mm in fruit, pubescent. Corolla light blue or light purple-red, ca. 2.5 mm, glabrous; throat appendages lunate; limb ca. 4 mm wide; lobes spreading, broadly ovate to suborbicular, ca. 1.8 mm. Anthers oblong, ca. 0.7 mm. Style ca. 0.7 mm. Nutlets light yellow-brown, 0.8–1 mm, smooth, shiny; cupular emergence of abaxial surfaces, ca. 1.5 in diam., ca. 0.8 mm high. Fl. and fr. May-Jul.

• Forests, hillside meadows, margins of rice fields, along streams, wet places at forest margins, thickets; ca. 100 m. Anhui, N Guangxi, Hunan, Jiangxi, Zhejiang.

**2. Omphalotrigonotis vaginata** Y. Y. Fang, Bull. Bot. Res., Harbin 7(1): 89. 1987.

具鞘皿果草 ju qiao min guo cao

Herbs perennial, minutely strigose. Stems branched near base, ca. 20 cm tall. Basal leaves 4 or 5; petiole ca. 5 cm, membranous and sheathing at base; leaf blade broadly elliptic, 0.8–1.6 cm × 6–12 mm, densely white strigose, base rounded to truncate, apex acute; stem leaves alternate, ovate-elliptic to elliptic, 1.7–3.5 × 0.7–1.5 cm. Cymes terminal, racemelike, 2–3 cm, ebracteate. Pedicel ca. 2 mm. Calyx 2.5–3 mm, to 4 mm in fruit, parted to base; lobes narrowly oblong. Corolla blue, ca. 6 mm; tube slightly longer than calyx; throat appendages semilunar; limb divaricate; lobes 5, elliptic-rounded, ca. 2.5 mm. Stamens inserted at middle of tube; filaments less than 1 mm, ca. as long as anthers. Style ca. 3 mm; stigma 2-lobed. Nutlets 4, tetrahedral, ca. 2 mm, affixed to gynobase at adaxial angle, with a cupular abaxial

projection.

• Zhejiang.

### 23. BRACHYBOTRYS Maximowicz ex Oliver, Hooker's Icon. Pl. 13: 43. 1878.

山茄子属 shan qie zi shu

Herbs perennial, with divaricate rhizomes. Leaves nearly whorled at stem apex. Calyx 5-parted to base; lobes subulate-lanceolate, slightly enlarged in fruit. Corolla subcampanulate; tube shorter than limb; throat appendages triangular-trapeziform, apex somewhat 2-cleft; lobes of limb ovate-oblong, ca. 5 mm, apex obtuse. Stamens inserted below throat, exerted; filaments subulate, base slightly expanded; anthers oblong, base slightly cordate, apex mucronulate. Ovary 4-parted. Style filiform, markedly exerted from corolla. Gynobase nearly flat. Nutlets black, tetrahedral, pubescent, shiny.

One species: NE China, Korea, E Russia.

#### 1. *Brachybotrys paridiformis* Maximowicz ex Oliver, Hooker's Icon. Pl. 13: 43. 1878.

山茄子 shan qie zi

Rhizomes ca. 3 mm in diam. Stems erect, not branched at apex, 30–40 cm tall, sparsely short strigose. Lower stem leaves scalelike; petiole of middle stem leaves 3–5 cm; leaf blade obovate-oblong, 2–5 cm, abaxially villous, adaxially sparsely short strigose, narrowly winged; upper 5 or 6 leaves pseudo-whorled, short petiolate, obovate to obovate-elliptic, 6–12 × 2–5 cm, abaxially sparsely short strigose, adaxially subglabrous, base cuneate, apex short acuminate. Inflorescences terminal, ca. 5 mm, densely short strigose, ca. 6-flowered, ebracteate. Pedicel 4–15 mm. Flowers crowded

on upper part of rachis. Calyx ca. 8 mm; lobes subulate-lanceolate, ca. 1.1 cm in fruit. Corolla purple, ca. 1.1 cm; tube ca. 1/2 as long as limb; appendages tongue-shaped; lobes ovate-oblong, ca. 6 mm. Stamens inserted below appendages; filaments ca. 4 mm; anthers exerted, ca. 3 mm, apex mucronulate. Style ca. 1.7 mm. Nutlets 3–3.5 mm, abaxial surfaces triangular-ovate, attachment scar near base. Fl. Apr–Jun.

2n = 24.

Forests, hillside meadows, field margins. Heilongjiang, Jilin, Liaoning [Korea, Russia (Primorye)].

The young leaves are used as a vegetable.

### 24. MERTENSIA Roth, Catal. Bot. 1: 34. 1797.

滨紫草属 bin zi cao shu

Herbs perennial, glabrous or pubescent, with thin rhizomes. Basal leaves usually withering early, ovate; stem leaves alternate. Cymes terminal, several flowered, becoming racemelike, ebracteate. Flowers pedicellate. Calyx 5-cleft or 5-parted, shorter than corolla tube; lobes lanceolate to ovate, not changing much in fruit. Corolla funnellform, usually sky blue or blue; throat with transverse folds or scalelike appendages; lobes spreading, ovate to oblong or semiorbicular, apex obtuse. Stamens inserted between appendages or slightly below; filaments short, filiform or ligulate; anthers oblong to ovate, longer than filaments, exerted. Ovary 4-parted. Style filiform, exerted from corolla. Gynobase conical. Nutlets tetrahedral, glabrous; adaxially sharp, sometimes nearly winged on keel; abaxially convex, wrinkled, tuberculate, rarely narrowly winged along margin; attachment scar at base adaxially.

About 15 species: Asia, E and NW Europe, North America; six species in China.

- 1a. Calyx parted to middle, lobes triangular; limb of corolla almost not developed, lobes straight; basal leaves not developed ..... 1. *M. tarbagataica*
- 1b. Calyx parted to base; limb of corolla well developed, lobes reclining; basal leaves developed.
  - 2a. Herbs pubescent.
    - 3a. Leaves oblong, stem leaves many; corolla bright blue or white (drying yellowish); style slightly exerted; nutlets white, rugate-tuberculate ..... 3. *M. davurica*
    - 3b. Basal leaves cordate-ovate or subreniform, stem leaves to 4; corolla sky blue; style long exerted; nutlets brown, pubescent, narrowly winged ..... 2. *M. dshagastanica*
  - 2b. Herbs glabrous, rarely sparsely pubescent on leaf margin and pedicel.
    - 4a. Leaf margin sparsely pubescent, leaf blade 2–4 cm; corolla dark blue ..... 4. *M. meyeriana*
    - 4b. Leaf margin glabrous, leaf blade longer; corolla sky blue.
      - 5a. Leaves fleshy, with white convex dots abaxially; corolla 1.2–1.4 cm; style to 3 mm, exerted from corolla ..... 5. *M. sibirica*
      - 5b. Leaves thin, without white dots; corolla 1.5–1.8 cm; style included ..... 6. *M. pallasii*

#### 1. *Mertensia tarbagataica* B. Fedtschenko, Trudy Imp. S.-Peterburgsk. Bot. Sada 15: 402. 1915. 浅裂滨紫草 qian lie bin zi cao

Herbs perennial, 10–15 cm tall, glaucous. Rhizomes thin,

creeping. Stems several, with brown scales basally, glabrous, carnosely. Basal leaves crowded, oblong-spatulate, base tapering to petiole. Upper 3–5 leaves cordate-ovate, 1–3 cm, glabrous, glaucous, fleshy, base somewhat clasping, apex obtuse. Inflorescences terminal, ebracteate, small, to 10-flowered, of which 2–5 are fertile. Pedicel short, 1–3 mm, fleshy. Calyx glaucous, parted to middle; lobes triangular to lanceolate, 4–5 mm. Corolla dark blue, 1.2–1.6 cm, tubular; throat appendages arclike; limb 1/3–1/2 as long as tube, indistinct; lobes oblong, ca. 2 mm. Filaments filiform, 1.5–2 mm, attached slightly below appendages, ca. as long as anthers. Styles long exserted. Nutlets ovoid-oblong, to 5 mm, abaxially rounded, apex acute. Fl. Jul, fr. Jul-Aug.

On crumbling slopes in subalpine and alpine zones; 2500–2800 m. NW Xinjiang (Karamay Xian, Tarbagatai Shan) [Kazakhstan].

**2. *Mertensia dshagastanica*** Regel, Trudy Imp. S.-Peterburgsk. Bot. Sada 6: 340. 1879.

蓝花滨紫草 lan hua bin zi cao

*Mertensianthe dshagastanica* (Regel) Popov.

Herbs perennial, 5–15 cm tall. Rhizomes short, thick, with black scales. Stems very slender, glabrate or appressed strigose. Petiole of basal leaves 3–12 cm; leaf blade green, cordate-ovate or subreniform, 2–4 cm, abaxially glabrous, adaxially strigose, apex acute or obtuse; stem leaves 4, lower 2 subopposite, upper 2 alternate, all sessile, ovate or oblong, small, apex acute. Inflorescences widely spaced, drooping to 1 side, 2–10-flowered, ebracteate. Pedicel threadlike, 5–12 mm, sparsely appressed bristly. Calyx parted to base, 3.5–4 mm; lobes linear, strigose, apex acute. Corolla sky blue, 1.3–1.5 cm; tube ca. 2 × as long as calyx and limb; appendages oblong, tall, apex rounded; limb narrow campanulate; lobes of limb ovate, 2–3 mm, apex obtuse. Filaments ca. 1/2 as long as linear-oblong anthers. Style exserted. Nectary 4-lobed, well developed. Nutlets ovate-conical, ca. 3 mm, hirsute, abaxially narrowly winged. Fl. Jun-Jul, fr. Jul-Aug.

On rocks; 2000–2200 m. W Xinjiang (Yili River basin, Pamirs, Altay Shan) [Kazakhstan, Tajikistan].

**3. *Mertensia davurica*** (Sims) G. Don, Gen. Hist. 4: 318. 1837.

长筒滨紫草 chang tong bin zi cao

*Pulmonaria davurica* Sims, Bot. Mag. 42: t. 1743. 1814; *Lithospermum davuricum* (Sims) Lehmann; *Mertensia ochroleuca* Ikonnikov-Galitzky.

Rhizomes black-brown, tuberlike. Stems single, erect, 20–30 cm tall. Basal leaves forming a rosette, crowded, long petiolate, ovate-oblong to linear-oblong, base cuneate to rounded; stem leaves only 3 or 4 per stem, subvertical, sessile, only lowest leaves petiolate but frequently withering early, lanceolate to linear-lanceolate, 1.5–3 cm × 1.5–3.5 mm, obscurely veined, abaxially glabrous, adaxially short appressed pubescent and tuberculate, apex obtuse to acuminate. Inflorescences branched, striate, glabrous at base, sparsely pubescent at apex. Cymes 1–1.5 cm, densely short appressed pubescent, usually 2 or 3 borne at apex of stem. Pedicel 2–5 mm. Calyx ca. 4.5 mm, 5-parted nearly to base;

lobes linear to linear-triangular. Corolla blue, 1.2–2.2 cm, glabrous; tube straight, ca. 3.5 × as long as limb, 2–3.5 mm wide; throat appendages lunate, ca. 0.5 mm, smooth; limb slightly wider than tube, 5-lobed; lobes slightly spreading, nearly semiorbicular, ca. 2 mm, margin entire. Stamens inserted between appendages; filaments ca. 2 mm; anthers linear-oblong, ca. 2.5 mm. Style ca. as long as corolla; stigma discoid. Nutlets ca. 2.5 mm, wrinkled; attachment scar narrowly triangular.  $2n = 24$ .

Hillside meadows. N Hebei [Mongolia, Russia].

**4. *Mertensia meyeriana*** J. F. Macbride, Contr. Gray Herb. 48: 52. 1916.

短花滨紫草 duan hua bin zi cao

*Mertensia popovii* Rubtzov.

Herbs perennial. Rhizomes short, thickened. Stems thin, 30–50 cm tall. Basal leaves early deciduous, ovate, small; stem leaves many, long petiolate, light green, ovate, 2–5 cm; upper leaves sessile, oblong, extremely thin, margin hirsute. Inflorescences terminal. Pedicel filamentous, to 1 cm, very short hirsute. Calyx parted to base, 4–4.5 mm; lobes linear, short strigose, apex acute. Corolla dark blue, (1.2–)1.5–2 cm; lobes of limb ovate, 3–4 mm; appendages arclike. Style slightly exserted. Nutlets white, oblong, ca. 4 mm, rugate, apex acute. Fl. Jun-Jul, fr. Jul-Aug.

Meadows of slopes, glades. NW Xinjiang (Saur Shan, Tarbagatai Shan) [Kazakhstan, W Mongolia].

**5. *Mertensia sibirica*** (Linnaeus) G. Don, Gen. Hist. 4: 319. 1837.

大叶滨紫草 da ye bin zi cao

*Pulmonaria sibirica* Linnaeus, Sp. Pl. 1: 135. 1753; *Lithospermum sibiricum* (Linnaeus) Lehmann; *Steenhammera sibirica* (Linnaeus) Turczaninow.

Rhizomes transversely spreading. Stems usually single, 30–60 cm tall, glabrous, sulcate, only inflorescences branched. Basal leaves petiole to 25 cm; leaf blade ovate to ovate-oblong, to 20 cm, fleshy, glaucous but abaxially with convex dots, base broadly cuneate or somewhat cordate, apex short acuminate; lateral veins arcuate, raised abaxially; stem leaves sessile, elliptic to linear-oblong, 3–7 × 1–1.2 cm, base attenuate, apex acute to acuminate. Cymes usually 2 or 3, terminal, becoming paniculate, 6–8 cm, glabrous, few flowered; rachis curved. Pedicel 2–7 mm, usually secund, slightly recurved. Flowers widely spaced. Calyx campanulate, ca. 5.5 mm, 5-parted nearly to base; lobes narrowly ovate to linear-ovate, apex obtuse. Corolla blue, ca. 1.4 cm; tube ca. 8 × 4.5 mm; throat appendages transverse folds, ca. 0.3 mm, smooth; limb slightly shorter than tube; lobes slightly spreading, broadly ovate, ca. 3.5 mm, margin entire or repand, apex obtuse, veins distinct. Stamens inserted below appendages; filaments strap-shaped, ca. 2.5 mm; anthers linear-oblong, ca. 3 mm, sparsely pubescent, base divergent, apex obtuse. Style filiform, ca. 1.5 cm, exserted ca. 3 mm from corolla; stigma discoid. Nutlets white, subreniform, 4–5 mm, slightly reticulate-wrinkled, glabrous. Fl. Jun-Jul, fr. Aug-Sep.  $2n = 24$ .

Hillside meadows; ca. 2500 m. Shanxi [Russia].

**6. *Mertensia pallasii*** (Ledebour) G. Don, Gen. Hist. 4: 319. 1837.

薄叶滨紫草 *bao ye bin zi cao*

*Lithospermum pallasii* Ledebour, Fl. Altaic. 1: 176. 1829.

Herbs perennial, rhizomatous. Stems simple, slender, 20–40 cm tall, thin, glabrous, sulcate. Basal and lower stem leaves petiolate, green, cordate-rounded or cordate-ovate, 4–6 cm, thin, delicate, apex obtuse. Upper stem leaves ± sessile,

apex acute. Inflorescences flat topped, small, few flowered. Pedicel threadlike, 4–5 mm, with 1 or 2 small leaves at base. Calyx parted to base, 4–5 mm; lobes linear, apex obtuse. Corolla bright blue, 1.5–1.8 cm; tube ca. 2 × as long as calyx; throat appendages arclike, low, appearing as brackets; limb campanulate, ca. 2/3 as long as tube, divided in upper 1/2; lobes ovate, to 1/2 of limb, apex obtuse. Filaments longer than anthers; anthers linear, 2–3 mm. Style ca. as long as corolla, slightly exerted or not. Nutlets white, ca. 4 mm, reticulate-rugate. Fl. May–Jun.

On shaded cliffs and rocks. NW Xinjiang (Altay Xian) [Kazakhstan, Russia].

## 25. AMBLYNOTUS (A. de Candolle) I. M. Johnston, Contr. Gray Herb. 73: 64. 1924.

钝背草属 *dun bei cao shu*

Herbs perennial, caespitose, strigose. Leaves alternate, oblanceolate, apex obtuse. Cymes bracteate. Calyx 5-parted to base; lobes erect, linear, slightly enlarged in fruit. Corolla blue; tube shorter than calyx; throat appendaged; limb broadly campanulate, 3–5 mm wide; lobes overlapping, apex obtuse. Stamens inserted at middle of corolla tube, included; filaments extremely short; anthers oblong, base and apex obtuse. Ovary 4-parted. Style included; stigma capitate. Gynobase nearly flat. Nutlets vertical, slightly curved, adaxially longitudinally keeled; abaxially convex, glabrous, shiny; attachment scar at base adaxially, triangular.

One species: China, Kazakhstan, Mongolia, and Russia.

**1. *Amblynotus rupestris*** (Pallas ex Georgi) Popov ex L. Sergievskaja in Krylov, Fl. W. Sib. 12(2): 3423. 1934.

钝背草 *dun bei cao*

*Myosotis rupestris* Pallas ex Georgi, Bemerkungen Reise Russe 1: 200. 1775; *Amblynotus obovatus* (Ledebour) I. M. Johnston; *Eritrichium davuricum* (Pallas ex Roemer & Schultes) Brand; *E. maackii* Maximowicz; *E. obovatum* (Ledebour) A. de Candolle; *Myosotis davurica* Pallas ex Roemer & Schultes; *M. obovata* Ledebour.

Stems several to numerous, erect, ascending or decumbent, slightly branched above, 6–8 cm tall, short strigose. Leaves densely strigose; basal and lower stem leaves narrowly spatulate, 0.7–1.5 cm × 2–3 mm, base attenuate to

a slender petiole; upper stem leaves sessile, narrowly obovate to linear-oblanceolate, smaller. Inflorescences 1–3 cm, densely short strigose, several flowered; bracts narrowly obovate to linear-oblanceolate, but smaller. Flowers short pedicellate. Calyx lobes ca. 2 mm, not enlarged in fruit. Corolla blue; tube ca. 1.5 mm; throat appendages lunate, fleshy; limb ca. 5 mm wide; lobes spreading, obovate to rotund, ca. 2 mm, margin entire. Anthers ca. 0.9 mm. Style ca. 1 mm; stigma capitate. Nutlets light yellow-white, oblique ovate, 1.5–2 mm, adaxially longitudinally keeled, abaxially rounded, apex obtuse. Seeds brown, dorsiventrally compressed, ovate. Fl. Apr–Jul.

W Heilongjiang, Nei Mongol, W Xinjiang [Kazakhstan, Mongolia, Russia].

## 26. MICROCARYUM I. M. Johnston, Contr. Gray Herb. 73: 63. 1924.

微果草属 *wei guo cao shu*

Herbs annual, villous. Leaves alternate. Cymes terminal, nearly umbel-like. Flowers pedicellate. Calyx 5-parted to base; lobes narrow, not enlarged in fruit. Corolla blue or white, broadly tubular to campanulate; tube ca. as long as calyx or slightly shorter; throat appendaged. Stamens inserted on middle of corolla tube, included; filaments extremely short; anthers ovate; ovary 4-parted. Stigma subcapitate. Gynobase terete. Nutlets oblong-ovate, vertical, adaxially with grooved longitudinal keel; abaxially rounded, wrinkled, glabrous, center line longitudinally keeled; attachment scar at base adaxially. Seeds straight; cotyledon complanate.

About three species: China, NE India; one species in China.

**1. *Microcaryum pygmaeum*** (C. B. Clarke) I. M. Johnston, Contr. Gray Herb. 73: 64. 1924.

微果草 *wei guo cao*

*Eritrichium pygmaeum* C. B. Clarke in J. D. Hooker, Fl. Brit. India 4: 165. 1883; *E. riae* C. Winckler.

Plants 1.5–5 cm tall. Stems erect, branched from base

or not. Leaves sessile, narrowly obovate to linear-oblong, 0.6–1.5 cm × 2–6 mm, sparsely villous, with hairs near leaf apices, hairs discoid at base, base attenuate, apex obtuse to acute. Cymes terminal. Pedicel unequal, 2.5–6 mm, pubescent. Calyx ca. 2 mm; lobes narrowly elliptic, densely white villous inside, sparsely pubescent outside, apex acute. Corolla blue or pink, glabrous; tube ca. as long as calyx;

throat light yellow; appendages lunate, slightly thickened, papillate, apex emarginate; limb ca. 3 mm wide; lobes suborbicular, ca. 1 mm. Anthers ca. 0.3 mm, apex mucronulate. Style ca. 1 mm. Nutlets ovate, slightly incurved,

ca. 1.1 mm, abaxially slightly keeled.

Alpine meadows; 3900–4700 m. W Sichuan [NE India].

## 27. CHIONOCHARIS I. M. Johnston, Contr. Gray Herb. 73: 66. 1924.

垫紫草属 dian zi cao shu

Herbs perennial, forming cushions. Leaves alternate, overlapping, crowded, flabellate. Flowers solitary, terminal, thin pedicellate. Calyx 5-parted to base; lobes linear-spatulate, not enlarged in fruit. Corolla campanulate; tube ca. as long as calyx; throat appendages 5; lobes of limb spreading, apex obtuse. Stamens inserted below throat appendages, included; filaments extremely short; anthers ovate, apex obtuse. Ovary 4-parted. Style short, included; stigma capitate. Gynobase low subulate. Nutlets ovate, abaxially orbicular, short pubescent; attachment scar at base adaxially. Seeds vertical; cotyledon complanate.

One species: Bhutan, China, NE India, Nepal.

**1. *Chionocharis hookeri*** (C. B. Clarke) I. M. Johnston, Contr. Gray Herb. 73: 66. 1924.

垫紫草 dian zi cao

*Myosotis hookeri* C. B. Clarke in J. D. Hooker, Fl. Brit. India 4: 174. 1883; *Eritrichium hookeri* (C. B. Clarke) Brand.

Plants 15–40 cm in diam. Stems crowded, much branched, ca. 3 cm tall. Leaf blade flabellate, 7–12 × 4–6 mm, abaxially glabrous or nearly so, adaxially and margin densely

white villous, base attenuate, apex acute. Pedicel 4–7 mm, glabrous. Calyx ca. 4.5 mm, villous inside and along margin, glabrous outside. Corolla light blue, ca. 7.5 mm, glabrous; tube ca. as long as calyx; throat appendages transverse folds or lunate, ca. 1 mm wide; limb 7–8 mm wide; lobes with thin veins. Stamens included; anthers ca. 1 mm. Style ca. 2 mm; stigma compressed globose. Nutlet short appressed pubescent abaxially.

Rocky slopes, precipices; 3500–5000 m. SW Sichuan, S Xizang, NW Yunnan [Bhutan, NE India, Nepal].

## 28. ERITRICHIUM Schrader, Comment. Soc. Regiae Sci. Gott. 4: 186. 1820.

齿缘草属 chi yuan cao shu

Plants perennial or annual, appressed strigose or villous. Leaves alternate. Cymes terminal, not branched or branched and paniculate, rarely 1-flowered. Fruiting pedicel erect or deflexed. Calyx 5-parted to base or nearly so; lobes vertical to reflexed, enlarged in fruit. Corolla blue, light blue, or light purple, rarely yellow or white, campanulate-rotate to campanulate-tubular; throat with appendages, rarely appendages obscure or absent; lobes overlapping in bud, erect or divaricate at anthesis. Stamens included; anthers orbicular, ovate to oblong. Style and stigma solitary, usually not exceeding nutlets. Gynobase flattened-fastigiate or semiglobose to 1 mm, wider than tall at base. Nutlets 4, all or some developed, turbinate to ovoid or triangular-ovoid and dorsiventrally compressed; abaxially usually discoid, ribs or margin usually winged, dentate or with glochids.

About 50 species: mainly in Asia, a few in Europe and North America; 39 species in China.

1a. Herbs annual or biennial.

2a. Corolla campanulate-rotate ..... 24. *E. heterocarpum*

2b. Corolla campanulate-tubular.

3a. Stems numerous, cespitose or diffuse, branched at base or not.

4a. Stems several, cespitose; inflorescences racemelike; corolla light blue, light purple, or yellow, appendages obscure ..... 28. *E. tangkulaense*

4b. Stems diffuse, prostrate; flowers solitary, axillary or extra-axillary; corolla white, appendages transverse linear ..... 29. *E. axillare*

3b. Stems single or few, markedly erect, much branched above.

5a. Flowers few, widely spaced; marginal glochids of nutlets needlelike, remote at base ..... 27. *E. acicularum*

5b. Flowers numerous, crowded; marginal glochids of nutlets lanceolate, base usually confluent into a wing.

6a. Nutlets with dense tubercles and bristles, marginal glochids ciliate, attachment scar slightly above middle adaxially ..... 25. *E. echinocaryum*

6b. Nutlets glabrous or sparsely pubescent, attachment scar at middle or slightly below adaxially ..... 26. *E. thymifolium*

1b. Herbs perennial.

- 7a. Stems slightly longer than basal leaves or not, base with crowded withered leaves and persistent petioles becoming cushionlike, or unbranched stems in leaf clusters forming rosettes.
- 8a. Stems single or several, basal leaves forming a rosette ..... 38. *E. villosum*
- 8b. Stems numerous, becoming cushionlike.
- 9a. Corolla campanulate-tubular.
- 10a. Stems usually ca. as long as basal leaves; leaf blade glabrous except for a few short hairs near apex of abaxial surface ..... 39. *E. hemisphaericum*
- 10b. Stems longer than basal leaves; leaf blade appressed white pubescent or spreading pilose.
- 11a. Stems 5–10 cm tall; leaf blade oblanceolate, apex obtuse; inflorescences 3–10-flowered; calyx lobes not reflexed in fruit; nutlets 1–1.2 mm excluding marginal glochids, marginal glochids free or nearly so at base ..... 22. *E. lasiocarpum*
- 11b. Stems 2–5 cm tall; leaf blade oblong to broadly elliptic or obovate, apex obtuse to acute; inflorescences 1–4-flowered; calyx lobes reflexed in fruit; nutlets 1.8–2 mm excluding marginal glochids, marginal glochids confluent below middle forming a broad wing ..... 23. *E. qofengense*
- 9b. Corolla campanulate-rotate.
- 12a. Marginal rib of nutlet winged or with prickles, usually without glochids.
- 13a. Nutlet margin winged, wing erose at margin ..... 21. *E. humillimum*
- 13b. Nutlet margin prickly, rarely with some glochids.
- 14a. Leaf blade spatulate; nutlets ca. 1 mm ..... 19. *E. pectinatociliatum*
- 14b. Leaf blade narrowly elliptic; nutlets ca. 2 mm ..... 20. *E. angustifolium*
- 12b. Marginal rib of nutlet with glochids at apex.
- 15a. Leaves with stiff bristles arising from basal tubercles abaxially; corolla white ..... 18. *E. deqinense*
- 15b. Leaves grayish strigose or with short appressed hairs abaxially; corolla blue or whitish.
- 16a. Plants 3–5 cm; leaf blade spatulate, 2–4 mm wide; attachment scar of nutlet below middle adaxially ..... 17. *E. sinomicrocarpum*
- 16b. Plants 5–15 cm; leaf blade spatulate-lanceolate or obovate-lanceolate, 4–8 mm wide; attachment scar of nutlet above middle adaxially.
- 17a. Basal leaves linear, indistinctly petiolate, 3–3.5 mm wide; limb of corolla ca. 4 mm wide ..... 15. *E. kangdingense*
- 17b. Basal leaves ovate-lanceolate, distinctly petiolate, 4–8 mm wide; limb of corolla 5–6 mm wide ..... 16. *E. laxum*
- 7b. Stems much longer than basal leaves, widely spaced, not cushion forming.
- 18a. Pedicel very short, 0.3–0.7 mm in fruit; leaf blade sparsely pubescent with tubercle-based bristles adaxially ..... 7. *E. fetisovii*
- 18b. Pedicel 1 mm or more, often much longer in fruit; leaf blade sparsely appressed white pubescent, strigose or appressed white sericeous.
- 19a. Pedicel erect to ascending, never curved.
- 20a. Leaf blade spatulate to ovate, sparsely appressed white pubescent or, if stem leaves narrowly lanceolate, strigose; nutlets dorsiventrally compressed or nearly so.
- 21a. Plants unequally strigose; leaf blade 3–8 mm wide; nutlets with fine tubercles and bristles abaxially ..... 35. *E. borealisinense*
- 21b. Plants sparsely appressed pubescent; leaf blade 3–5 mm wide; nutlets glabrous or only short hispid abaxially.
- 22a. Basal leaves spatulate, adaxially glabrous or sparsely spreading pilose; nutlets glabrous or with few short hairs, 2–3.5 mm excluding marginal glochids ..... 30. *E. spathulatum*
- 22b. Basal leaves ovate-lanceolate, adaxially with few long appressed hairs; nutlets minutely hispid, 1.7–2 mm excluding marginal glochids ..... 31. *E. fruticosum*
- 20b. Leaf blade lanceolate to linear, densely appressed white sericeous; nutlets turbinate.
- 23a. Marginal glochids of nutlet mostly anchorlike at apex ..... 32. *E. canum*
- 23b. Marginal glochids of nutlet absent or not clearly anchorlike at apex.
- 24a. Margin of nutlet not winged, usually without glochids, or sometimes with few fine teeth ..... 37. *E. mandshuricum*
- 24b. Margin winged, with comblike, usually bluish teeth, apex sometimes with glochids.
- 25a. Pedicel 10–20 mm; marginal glochids of nutlets slender, irregular ..... 34. *E. incanum*

- 25b. Pedicel 3–5 mm; marginal glochids of nutlets triangular to triangular-lanceolate.
- 26a. Basal leaves ca. 2 cm; marginal glochids of nutlets curved toward center ..... 33. *E. gracile*
- 26b. Basal leaves 3–6 cm; marginal glochids of nutlets not curved toward center ..... 36. *E. pauciflorum*
- 19b. Pedicel curved, sometimes pendulous.
- 27a. Stem leaves oblong-linear to oblong-ob lanceolate, 2–3 mm wide.
- 28a. Stems branched; fruiting pedicel ca. 1 mm; nutlets with marginal glochids ca. 1.2 mm ..... 12. *E. sessilifructum*
- 28b. Stems not branched; fruiting pedicel 5–10 mm; nutlets with marginal glochids ca. 0.4 mm.
- 29a. Nutlets adaxially glabrous, marginal glochids confluent ..... 13. *E. longifolium*
- 29b. Nutlets adaxially pubescent, marginal glochids free ..... 14. *E. subjacquemontii*
- 27b. Stem leaves lanceolate to ovate, (4–)7–15 mm wide.
- 30a. Corolla blue.
- 31a. Marginal glochids of nutlets confluent into a broad wing ..... 9. *E. petiolare*
- 31b. Marginal glochids of nutlets free at base.
- 32a. Stem leaves oblanceolate to elliptic, abruptly constricted into a conspicuous petiole; pedicel 1.5–2 cm in fruit; attachment scar of nutlet above middle adaxially ..... 10. *E. longipes*
- 32b. Stem leaves lanceolate to linear, sessile; pedicel not exceeding 1 cm in fruit; attachment scar of nutlet below middle adaxially ..... 11. *E. medicarpum*
- 30b. Corolla white.
- 33a. Leaf blade ovate to elliptic, apex obtuse ..... 3. *E. pseudolatifolium*
- 33b. Leaf blade lanceolate to ovate-lanceolate, apex acuminate to acute.
- 34a. Marginal ribs of nutlets without glochids.
- 35a. Plants less than 10 cm; pedicel 0.5–1 mm; marginal ribs of nutlets with triangular teeth ..... 4. *E. confertiflorum*
- 35b. Plants 20–50 cm tall; pedicel 5–10 mm at anthesis, to 2–4 cm in fruit; marginal ribs of nutlets with a few fine emergences ..... 5. *E. pendulifructum*
- 34b. Marginal ribs of nutlets with glochids.
- 36a. Glochids of nutlet rib margin 0.5–1.2 mm.
- 37a. Leaf blade acuminate to acute at apex, with few hairs abaxially; abaxial surface of nutlets ovate-triangular, attachment scar slightly below middle adaxially ..... 1. *E. pamiricum*
- 37b. Leaf blade acute to rounded at apex, pubescent; abaxial surface of nutlets ovate to broadly ovate, attachment scar at middle adaxially ..... 2. *E. latifolium*
- 36b. Glochids of nutlet rib margin not exceeding 0.5 mm.
- 38a. Plants densely spreading hispid; fruiting pedicel to 1.5 cm; anchorlike marginal glochids of nutlets triangular ..... 8. *E. deltodentum*
- 38b. Plants pubescent; fruiting pedicel 3–5 mm; anchorlike marginal glochids of nutlets free at base ..... 6. *E. oligacanthum*

**1. *Eritrichium pamiricum*** B. Fedtschenko, Trudy Imp. S.-Peterburgsk. Bot. Sada 21: 385. 1903.

帕米尔齿缘草 pa mi er chi yuan cao

*Hackelia pamirica* (B. Fedtschenko) Brand.

Herbs perennial, (15–)20–25(–30) cm tall. Stems several, cespitose, sparsely pubescent, with persistent withered leaves and branches at base. Petiole of basal leaves 3–6 cm, to 1 cm in stem leaves; leaf blade lanceolate to elliptic-lanceolate, 3–5.5 × 0.8–1.5 cm, pubescent, abaxially more densely pubescent, apex acuminate to acute. Inflorescences 2–4, terminal on stems, usually 4–10-flowered, forming 1 or 2 verticillasters on branches. Pedicel 3–6 mm, erect at anthesis, elongated in fruit, sparsely pubescent. Calyx lobes erect, ovate-oblong, ca. 1 mm at anthesis, to 1.5 mm in fruit,

strigose, apex acute. Corolla white, campanulate-rotate; tube 0.7–1 mm; appendages lunate, papillate, apex 2-cleft; limb ca. 6 mm wide; lobes orbicular-ovate, 1.5–2 mm. Anthers broadly elliptic, ca. 0.5 mm. Style ca. 1 mm. Gynobase ca. 1 mm. Nutlets dorsiventrally compressed, 2–3 × 1–1.5 mm excluding marginal glochids, keeled adaxially, finely tuberculate and slightly hispid; disc ovate-triangular, flat or slightly convex, densely hispid; marginal glochids 0.2–0.5 mm, free or slightly united at base, anchorlike at apex; attachment scar below middle adaxially. Fl. and fr. Jun–Jul.

Grasslands; ca. 3200 m. Xinjiang (Hotan Xian) [Kazakhstan, Kyrgyzstan, Russia, Tajikistan, Turkmenistan, Uzbekistan].

**2. *Eritrichium latifolium*** Karelin & Kirilov, Bull. Soc. Imp. Naturalistes Moscou 15: 407. 1842.

宽叶 齿缘草 kuan ye chi yuan cao

Herbs perennial, 15–20 cm tall. Stems several, cespitose, not branched, pubescent, with persistent withered leaves and branches at base. Basal leaves several; petiole 3–5 cm; leaf blade lanceolate to elliptic-lanceolate, 4.5–6 × 1.5–2 cm, pubescent, base attenuate, apex rounded to obtuse; stem leaves lanceolate, 1–4 cm × 5–12 mm, base cuneate, apex pungent. Inflorescences 2 or 3, terminal on stems. Pedicel 3–6 mm, sparsely pubescent, lowest pedicel to 3 cm. Calyx lobes ovate-oblong to ovate-lanceolate, ca. 1 mm, slightly enlarged in fruit, densely appressed pubescent outside, subglabrous inside. Corolla white, campanulate-rotate; tube ca. 1 mm; appendages nearly semiorbicular, fleshy, distinctly exerted, basal center papillate; limb 5.5–6 mm wide; lobes obovate, 1.5–2 mm. Anthers oblong. Gynobase ca. 1 mm. Style ca. 1 mm. Nutlets dorsiventrally compressed, 2.5–3 × 1.5–2 mm excluding marginal glochids, sparsely pubescent adaxially; disc ovate to broadly ovate, slightly convex, with many hairs; marginal glochids triangular-lanceolate, 0.5–1.2 mm, free or confluent into a wing; attachment scar at middle adaxially, ovate. Fl. and fr. Jun-Jul.

Meadows, thickets, marshes, forest margins; 2000–3200 m. Xinjiang [Kazakhstan].

**3. *Eritrichium pseudolatifolium*** Popov in Komarov, Fl. URSS 19: 708. 1953.

对叶齿缘草 dui ye chi yuan cao

Herbs perennial, 15–30 cm tall. Stems several, cespitose, frequently bifurcate branched, pubescent, with persistent withered leaves and branches at base. Petiole of basal leaves 3–9 cm; leaf blade ovate to elliptic, 1–2.5 × 0.8–1.3 cm, abaxially short appressed pubescent, adaxially glabrescent, base rotund, apex obtuse; stem leaves 4 or 5, uppermost becoming involucrel, ± sessile, ovate to broadly ovate, 1–1.5 cm × 6–10 mm. Inflorescences axillary or extra-axillary. Pedicel 4–7 mm, sparsely pubescent. Calyx lobes erect at anthesis, divaricate in fruit, linear-oblong to ovate-oblong, ca. 1.5 mm, appressed pubescent outside, glabrescent inside. Corolla white, campanulate-rotate; tube ca. 2 mm; appendages trapeziform, distinctly exerted, with an emergence inside; limb ca. 7 mm wide; lobes broadly obovate, or suborbicular. Anthers subglobose, ca. 0.5 mm in diam. Gynobase ca. 0.5 mm. Style ca. 0.1 mm. Nutlets dorsiventrally compressed, short pubescent, ca. 1.5 × 1 mm excluding marginal glochids, base rounded and obtuse, apex acuminate; disc ovate to narrowly ovate, slightly convex; marginal glochids triangular to lanceolate, free; attachment scar above middle adaxially, ovate.

Moist stream banks, alpine crevices; 3000–3400 m. Xinjiang [Kazakhstan, Kyrgyzstan, Russia, Tajikistan, Turkmenistan, Uzbekistan].

**4. *Eritrichium confertiflorum*** W. T. Wang in W. T. Wang, Y. S. Lian, & J. Q. Wang, Bull. Bot. Lab. N. E. Forest. Inst., Harbin 9: 35. 1980.

密花齿缘草 mi hua chi yuan cao

Herbs perennial, less than 10 cm tall. Stems several, cespitose, not branched, densely short appressed pubescent, persistent withered leaves and persistent branches at base. Petiole of basal leaves 2–5 cm; leaf blade ovate-lanceolate to ovate-elliptic, 1.5–4.5 cm × 5–12 mm, short appressed pubescent, base broadly cuneate, apex acuminate to acute; stem leaves 3–6, petiolate below, ± sessile above, 2 leaves of contiguous inflorescences subopposite, becoming involucrel. Inflorescences 2 or 3, terminal, 1–4 cm. Pedicel 0.5–1 mm, sparsely pubescent. Calyx lobes linear to linear-lanceolate, 2–2.5 mm, slightly enlarged in fruit, appressed pubescent outside, with few short hairs inside. Corolla white, campanulate-rotate; appendages trapeziform, distinctly exerted, ca. 1 mm, each with a tubercle inside; limb ca. 6 mm wide; lobes obovate, ca. 2.5 mm. Anthers elliptic, ca. 1 mm. Gynobase ca. 0.5 mm. Nutlets dorsiventrally compressed, ca. 2.5 × 1.5 mm, adaxially glabrous or with few hairs, keeled above attachment scar; disc ovate-triangular, slightly convex, glabrous or sparsely pubescent, with distinct midvein, marginal rib slightly protruding, frequently with several triangular teeth on middle and below, tips not anchorlike; attachment scar slightly above middle adaxially, ovate to suborbicular. Fl. and fr. Jul-Aug.

• Alpine crevices; ca. 2200 m. Xinjiang (Ürümqi Shi).

**5. *Eritrichium pendulifructum*** Y. S. Lian & J. Q. Wang in W. T. Wang, Y. S. Lian, & J. Q. Wang, Bull. Bot. Lab. N. E. Forest. Inst., Harbin 9: 36. 1980.

垂果齿缘草 chui guo chi yuan cao

Herbs perennial, 20–50 cm tall. Stems arcuate ascending, 2–3 mm in diam., densely pubescent. Petiole of basal leaves 2–3 cm; stem leaves short petiolate or ± sessile, ovate-lanceolate to elliptic, 2–3 cm × 6–12 mm, pubescent, base cuneate to broadly cuneate, apex acuminate to acute. Inflorescences widely spaced, conjugately terminating stem, to 25 cm in fruit. Pedicel 5–10 mm at anthesis, to 2–4 cm in fruit, pubescent; bracts linear. Calyx lobes erect, linear to lanceolate, ca. 1.5 mm at anthesis, enlarged in fruit, divaricate or reflexed, pubescent. Corolla white, campanulate-rotate; appendages low trapeziform, slightly exerted; limb 5–6 mm wide; tube ca. 1.5 mm; lobes obovate, ca. 2.5 mm. Anthers oblong, ca. 1 mm. Gynobase ca. 0.5 mm. Style ca. 1 mm. Nutlets dorsiventrally compressed; adaxially sparsely pubescent, keeled above attachment scar; disc ovate to ovate-triangular, slightly convex, sparsely pubescent, marginal rib with a few fine emergences; attachment scar below middle adaxially, prominent, becoming carpophore to 0.8 mm. Fl. Aug.

• Foothills; ca. 2300 m. Xinjiang (Heshuo Xian).

**6. *Eritrichium oligacanthum*** Y. S. Lian & J. Q. Wang in W. T. Wang, Y. S. Lian, & J. Q. Wang, Bull. Bot. Lab. N. E. Forest. Inst., Harbin 9: 37. 1980.

疏刺齿缘草 shu ci chi yuan cao

Herbs perennial, 30–40 cm tall. Stems numerous, cespitose, not branched, pubescent. Petiole of basal leaves 2.5–4 cm; leaf blade ovate to elliptic, 2.5–4.5 × 1.5–2 cm,

sparsely pubescent, base rounded to attenuate, apex acute to rounded; stem leaves short petiolate to sessile, oblong to narrowly elliptic. Inflorescences 2 or 3, terminal, few flowered, 2–6 cm, ebracteate. Pedicel 3–5 mm, somewhat pubescent. Calyx lobes narrowly ovate to ovate, ca. 1.5 mm at anthesis, slightly enlarged in fruit, with many white hairs outside, sparsely short pubescent inside. Corolla white, campanulate-rotate; tube ca. 1.5 mm; appendages low trapeziform, slightly exerted, ca. 0.5 mm, with a papillate emergence; lobes suborbicular to obovate, ca. 2.5 mm. Anthers oblong, ca. 0.5 mm. Gynobase ca. 1 mm. Nutlets dorsiventrally compressed, ca. 2.5 mm excluding marginal glochids, sparsely pubescent; adaxially convex, somewhat pubescent, sparsely tuberculate; disc broadly ovate; marginal glochids 0.3–0.5 mm, free; attachment scar at middle adaxially, ovate. Fl. Jul.

- Mountains; ca. 2700 m. Xinjiang (Hejing Xian).

**7. *Eritrichium fetisovii*** Regel, Trudy Imp. S.-Peterburgsk. Bot. Sada 6: 340. 1879.

短梗齿缘草 duan geng chi yuan cao

Herbs perennial, 30–40 cm (or more) tall. Stems 1 or 2, not caespitose, not branched, sparsely pubescent. Basal and lower stem leaves long petiolate, green, oblong-lanceolate, to 5–6 cm × (6–)8–10 mm, sparsely pubescent, adaxially with bristles borne on white tubercles, apex obtuse; upper stem leaves sessile, lanceolate, apex acute. Inflorescences small, elongated in fruit. Pedicel very short, distinct only in fruit, 0.3–0.7 mm. Calyx lobes ovate, ca. 2 mm, gray pubescent, apex obtuse. Corolla white, campanulate-rotate; appendages 0.8–1 mm, thick, 2-lobed at apex; limb to 5 mm; lobes ovate, rounded. Gynobase very short, to 1 mm. Nutlets dorsiventrally compressed, ca. 3 mm, glabrous or pubescent; disc with marginal glochids confluent into a narrow scarious dentate wing. Fl. Jun-Jul, fr. Jul.

Damp places between cliffs and in shrubs along streams. W Xinjiang (Yeli River basin) [Kyrgyzstan].

**8. *Eritrichium deltodontum*** Y. S. Lian & J. Q. Wang in W. T. Wang, Y. S. Lian, & J. Q. Wang, Bull. Bot. Lab. N. E. Forest. Inst., Harbin 9: 38. 1980.

三角刺齿缘草 san jiao ci chi yuan cao

Herbs perennial, 20–30 cm tall. Stems caespitose, erect to ascending, densely pubescent. Petiole of basal leaves 2–4 cm, pubescent; leaf blade narrowly elliptic to oblanceolate, 2–3 × ca. 1 cm, densely white hispid, base attenuate, apex acute; stem leaves ± sessile, elliptic to ovate, 1–2 cm × 4–10 mm. Inflorescences terminal on stems and branches, to 10 cm in fruit, becoming racemose. Pedicel pubescent, 3–5 mm at anthesis, elongated to 1.5 cm. Calyx lobes linear, ca. 2 mm, narrowly ovate to ovate, ca. 1.5 mm at anthesis, slightly enlarged in fruit, with many white hairs outside, sparsely short pubescent inside. Corolla white, campanulate-rotate; tube ca. 1.5 mm; appendages transversely oblong, distinctly exerted from throat; lobes suborbicular, ca. 2 mm wide. Anthers ovate, ca. 0.5 mm. Gynobase ca. 1 mm. Nutlets dorsiventrally compressed, ca. 2.5 mm excluding marginal glochids, sparsely pubescent, adaxially tuberculate and

somewhat pubescent; disc triangular-ovate, slightly convex, with many hairs; marginal glochids triangular, free or somewhat confluent at base; attachment scar at middle or slightly below adaxially, becoming carpophorelike. Fl. Jul.

- Valley meadows; ca. 2800 m. Xinjiang.

**9. *Eritrichium petiolare*** W. T. Wang in W. T. Wang, Y. S. Lian & J. Q. Wang, Acta Phytotax. Sin. 18: 516. 1980.

具柄齿缘草 ju bing chi yuan cao

Herbs perennial, to 20 cm tall. Stems several, caespitose, not branched or only branched above. Basal leaves oblanceolate to narrowly oblong, 2–8 cm × 2–10 mm, base attenuate into a petiole, apex obtuse to rounded; stem leaves ± sessile, 1 or 2 leaves subtending inflorescences, wider and involucrelike; leaf blade oblanceolate-oblong to oblong, 1.5–2.5 cm. Inflorescences terminal, becoming racemose. Fruiting pedicel to 1.3 cm, sparsely pubescent; bracts narrowly ovate to ovate. Calyx lobes ovate to ovate-oblong, 2–2.5 mm, short appressed pubescent outside, sparsely short appressed pubescent inside above middle. Corolla blue, campanulate-rotate; tube ca. 2 mm; appendages low trapeziform, slightly surpassing throat, pubescent apically and laterally, with an obovate emergence inside; lobes elliptic, ca. 3 mm. Stamens inserted at middle of corolla tube; anthers ovate, ca. 0.6 mm. Gynobase ca. 0.5–0.7 mm in fruit. Nutlets dorsiventrally compressed, ca. 2.5 × 2 mm excluding marginal glochids, glabrous or sparsely pubescent, adaxially keeled, abaxially slightly convex; marginal glochids triangular, usually bluish, confluent at base into a broad wing; attachment scar at middle adaxially. Fl. and fr. Jul-Aug.

- Mountain meadows, rock crevices, thickets, ravines; 4500–5100 m. Xizang.

- 1a. Plants to 10 cm tall; leaf blade densely appressed pubescent; inflorescences 1–3 cm ..... 9b. var. *subturbanatum*
- 1b. Plants 10–20 cm tall; leaf blade with sparse or spreading hairs; inflorescences 5–10 cm.
  - 2a. Plants sparsely short appressed pubescent; inflorescences ca. 10 cm ..... 9a. var. *petiolare*
  - 2b. Plants spreading villous; inflorescences ca. 5 cm ..... 9c. var. *villosum*

**9a. *Eritrichium petiolare* var. *petiolare***

具柄齿缘草 (原变种) ju bing chi yuan cao (yuan bian zhong)

Plants 10–20 cm tall, sparsely short appressed pubescent. Leaf blade 3–10 mm wide. Inflorescences to 10 cm. Fl. and fr. Jul-Aug.

- Mountain meadows, rock crevices. Xizang.

**9b. *Eritrichium petiolare* var. *subturbanatum*** W. T. Wang in W. T. Wang, Y. S. Lian, & J. Q. Wang, Acta Phytotax. Sin. 18: 516. 1980.

陀果具柄齿缘草 tuo guo ju bing chi yuan cao

Plants not greater than 10 cm tall. Leaf blade 2–4 mm wide, densely minute strigose. Inflorescences 1–3 cm.

• Rocky crevices on open slopes, gravelly areas, thickets; ca. 5100 m. Xizang.

**9c. *Eritrichium petiolare* var. *villosum*** W. T. Wang in W. T. Wang, Y. S. Lian, & J. Q. Wang, *Acta Phytotax. Sin.* 18: 516. 1980.

柔毛具柄齿缘草 rou mao ju bing chi yuan cao

Plants 10–20 cm tall, spreading villous. Inflorescences ca. 5 cm.

• Ravines, rock crevices; 4500–5000 m. Xizang.

**10. *Eritrichium longipes*** Y. S. Lian & J. Q. Wang in W. T. Wang, Y. S. Lian, & J. Q. Wang, *Bull. Bot. Lab. N. E. Forest. Inst., Harbin* 9: 40. 1980.

长梗齿缘草 chang geng chi yuan cao

Herbs perennial, 15–25 cm tall. Stems several, cespitose, not branched or branched above, short appressed pubescent. Petiole of lower stem leaves ca. 3 mm; leaf blade oblanceolate to oblong, 2–4 cm, base attenuate, apex rounded to acuminate; upper stem leaves short petiolate or ± sessile, narrowly ovate to elliptic, 1.5–3 cm, base broadly cuneate, apex acute. Inflorescences terminal, to 10 cm in fruit; bracts leaflike. Pedicel 2–5 mm at anthesis, to 1.5–2 cm in fruit, appressed pubescent. Calyx lobes erect at anthesis, divaricate in fruit, lanceolate to linear, ca. 2 mm, appressed pubescent. Corolla blue, campanulate-rotate; tube ca. 2 mm; appendages low trapeziform, slightly surpassing throat, ca. 0.5 × 1 mm; limb ca. 5 mm wide; lobes suborbicular, ca. 3 mm. Anthers elliptic, ca. 1 mm. Nutlets dorsiventrally compressed, ca. 1.5 × 1.3 mm excluding marginal glochids; adaxially protruding, sparsely pubescent; abaxially ovate, slightly convex, minutely hispid, marginal glochids free; attachment scar above middle adaxially, ovate, smooth. Fl. Jul.

• Shaded rocky slopes, rocky crevices; ca. 3700 m. Qinghai (Yushu Xian).

**11. *Eritrichium medicarpum*** Y. S. Lian & J. Q. Wang in W. T. Wang, Y. S. Lian, & J. Q. Wang, *Bull. Bot. Lab. N. E. Forest Inst., Harbin* 9: 41. 1980.

青海齿缘草 qing hai chi yuan cao

Herbs perennial, 10–40 cm tall. Stems single or several and cespitose, appressed pubescent. Petiole of basal leaves 3–4 cm; leaf blade oblanceolate, 2–4 cm × 4–6 mm, appressed pubescent; stem leaves sessile, lanceolate to linear, 2–4 cm × 3–7 mm. Inflorescences terminal or axillary above, 5–10-flowered, frequently extra-axillary outside bracts. Pedicel 3–10 mm, short pubescent. Calyx lobes linear, ca. 2 mm, short appressed pubescent outside, with few hairs inside. Corolla blue or blue-purple, campanulate-rotate; tube ca. 1.5 mm; appendages low trapeziform or nearly square, ca. 0.5 mm, frequently papillate; limb 4–6 mm wide; lobes obovate to suborbicular, ca. 2.5 mm. Stamens inserted on middle of corolla tube; anthers ovate, ca. 0.5 mm. Style ca. 1 mm. Nutlets dorsiventrally compressed, sparsely pubescent, 2.5–3 × ca. 1.2 mm excluding glochids, adaxially protruding, abaxially slightly convex; marginal glochids to 1.9 mm, apex anchorlike; attachment scar below middle adaxially. Fl. and fr. Jul–Aug.

• Slopes, forests, thickets; 3600–3800 m. Qinghai.

**12. *Eritrichium sessilifructum*** Y. S. Lian & J. Q. Wang in W. T. Wang, Y. S. Lian, & J. Q. Wang, *Bull. Bot. Lab. N. E. Forest. Inst., Harbin* 9: 42. 1980.

无梗齿缘草 wu geng chi yuan cao

Herbs annual, 15–20 cm tall. Stems ascending, short appressed pubescent. Petiole of lower leaves 3–5 mm; upper leaves ± sessile. Leaf blade oblong to linear-oblanceolate, 0.5–2 cm × 2–3 mm, appressed pubescent, base attenuate, apex rounded. Inflorescences axillary or extra-axillary, 1-flowered. Pedicel ca. 1 mm, appressed pubescent. Flowers and fruits sessile or nearly so. Calyx lobes erect at anthesis, divaricate in fruit, lanceolate, ca. as long as to slightly longer than tube, ca. 0.7 mm, to 1 mm in fruit. Corolla campanulate-tubular, 1–1.2 mm; appendages obscure; lobes suborbicular, ca. 0.5 mm wide. Nutlets turbinate; abaxially triangular-ovate, ca. 1.5 × 1 mm, sparsely pubescent; marginal glochids stiff, ca. 1.2 mm, free at base; attachment scar at middle adaxially, narrowly ovate.

• Grasslands, rocky river banks; ca. 2000 m. Xinjiang (Hotan Xian).

**13. *Eritrichium longifolium*** Decaisne in Jacquemont, *Voy. Inde* 124. 1844.

阿克陶齿缘草 a ke tao chi yuan cao

*Eritrichium aktonense* Lian & J. Q. Wang.

Herbs perennial, 5–40 cm tall. Stems erect to ascending, appressed white pubescent. Basal leaves petiolate; stem leaves ± sessile; leaf blade oblanceolate to linear-oblong, 1–1.5 cm × 2–3 mm, appressed pubescent, base attenuate, apex rounded. Inflorescences terminal on branches, elongated, becoming racemose, to 10 cm in fruit; bracts leaflike. Pedicel 3–5 mm at anthesis, to 1 cm in fruit, oblique or recurved upward, appressed pubescent. Calyx lobes appressed, oblanceolate, 1.5–2.5 mm. Corolla light blue, campanulate-rotate; tube ca. 1.5 mm; appendages papillate, ca. 0.5 mm wide; limb ca. 6 mm wide; lobes obovate, ca. 2.5 mm. Anthers elliptic, ca. 0.5 mm. Nutlets dorsiventrally compressed, ca. 2.5 × 1.5 mm excluding marginal rib; adaxially keeled, glabrous or sparsely pubescent; abaxially ovate, convex, with many short hairs; marginal glochids ovate-triangular, ca. 0.3 mm, confluent into wings; attachment scar at middle adaxially, broadly ovate to ovate, ca. 0.5 mm, with aperture at center. Fl. Jun.

• Rocky slopes; ca. 3500 m. Xinjiang.

**14. *Eritrichium subjacquemontii*** Popov in Komarov, *Fl. URSS* 19: 709. 1953.

新疆齿缘草 xin jiang chi yuan cao

Herbs perennial. Stems several, cespitose, prostrate to ascending, not branched, 5–15 cm tall. Basal leaves linear-spatulate, 1.5–3 cm × 2–3 mm including petiole, densely short sericeous, long petiolate, base attenuate into a petiole, apex rounded; stem leaves short petiolate or sessile, linear-oblong,

1–1.5 cm × 1–4 mm, base attenuate, apex rounded. Inflorescences terminal, widely spaced. Pedicel sparsely pubescent, 1–1.5 cm in fruit, recurved. Calyx lobes oblong-linear, 1–2 mm, sericeous, apex acute. Corolla light blue; tube ca. as long as calyx, ca. 1 mm; appendages ovate to nearly trapeziform, ca. 0.3–0.5 mm, papillose; limb 4–5 mm wide; lobes obovate. Stamens inserted at middle of corolla tube; anthers ovate to ovate-triangular. Developed nutlets usually 1 or 2, dorsiventrally compressed, sparsely pubescent, 2–2.5 × ca. 1 mm; adaxially sparsely pubescent, keeled above; abaxially ovate-triangular, flat or slightly convex; marginal glochids 3–8 on each side, extremely short, straight, free at base; attachment scar nearly at middle adaxially, prominent, becoming carpophorelike. Fl. and fr. Jun-Jul.

Gravelly slopes, sandy marshes, rocky crevices; 2700–3900 m. Xinjiang [Kazakhstan, Kyrgyzstan, Russia, Tajikistan, Turkmenistan, Uzbekistan].

**15. *Eritrichium kangdingense*** W. T. Wang, Bull. Bot. Res., Harbin 6(3): 92. 1986.

康定齿缘草 kang ding chi yuan cao

Herbs perennial, caespitose. Stems 8–11 cm tall, strigose, branched at apex, with 5–9 leaves. Basal leaves densely rosulate, linear, 5–6 cm × 3–4 mm, leathery when dry, densely grayish strigose, base tapering into indistinct petiole, apex subobtuse; leaf blade of stems similar, 0.8–1.6 cm × 1.5–2.2 mm. Cymes often branched, 2–3 cm, axis and pedicel strigose; bracts basal, lanceolate to narrowly elliptic, 3–9 mm. Pedicel 3–5 mm in fruit. Calyx lobes broadly linear, ca. 0.4 mm, strigose on both sides. Corolla blue, glabrous; tube ca. 1.3 mm, faucal appendages low trapeziform, ca. 0.4 mm; limb ca. 4 mm wide; lobes suborbicular. Anthers elliptic, ca. 0.4 mm. Nutlets 4, dorsiventrally compressed, adaxially sparsely puberulent; abaxially plane, ovate, ca. 1.5 × 1 mm, sparsely puberulent, apex with 5–8 minutely barbed, triangular-linear glochids, 0.5–1 mm; marginal glochids on each side; attachment scar at middle adaxially. Fl. and fr. Jul.

• In gravelly glacial valleys; 3600–4000 m. Sichuan.

**16. *Eritrichium laxum*** I. M. Johnston, J. Arnold Arbor. 33: 66. 1952.

疏花齿缘草 shu hua chi yuan cao

Herbs perennial, 5–15 cm tall. Stems caespitose, erect to decumbent, sparsely appressed pubescent. Petiole of basal leaves 1–4 cm; leaf blade ovate-lanceolate; stem leaves ± sessile, oblanceolate, 1–3 cm × 4–8 mm, short appressed pubescent, base cuneate, apex acute. Inflorescences axillary below 1–2 cm, racemose above. Pedicel of axillary flowers to 2.5 cm, sparsely pubescent. Calyx lobes linear to oblanceolate, 1.5–2 mm, slightly elongated in fruit, strigose outside, sparsely appressed pubescent inside. Corolla white or light blue, campanulate-rotate; tube 1.3–1.7 mm; appendages lunate; limb 5–6 mm wide; lobes suborbicular, 2.2–2.5 mm. Stamens inserted on middle of corolla tube; anthers oblong. Gynobase to 1 mm in fruit. Nutlets dorsiventrally compressed, sparsely pubescent, 1.5–1.7 × ca. 1 mm excluding marginal glochids; adaxially protruding, sparsely pubescent; abaxially flat or somewhat convex, ovate-

triangular, with few hairs; marginal glochids 0.2–0.4(–0.6) mm, free at base; attachment scar at upper 3/8 adaxially, smaller, orbicular, convex. Fl. and fr. Jun-Aug.

• Meadows, rocky ridges; 4000–5000 m. S Qinghai (Nangqên Xian), S Xizang, NW Yunnan.

**17. *Eritrichium sinomicrocarpum*** W. T. Wang, Fl. Reipubl. Popularis Sin. 64(2): 133. 1989.

小果齿缘草 xiao guo chi yuan cao

*Eritrichium microcarpum* W. T. Wang (1980), not de Candolle (1846).

Herbs perennial, cushionlike, 3–5 cm tall. Stems caespitose, much branched at base, with many withered leaves and persistent bases. Leaf blade spatulate, 1–2 cm × 2–4 mm, with many white hairs, base attenuate becoming petiole, margin ciliate, apex obtuse to acute. Inflorescences terminal, racemose, 1–1.5 cm, 3–5-flowered. Pedicel 2–6 mm, erect to ascending. Calyx lobes erect at anthesis, lanceolate, linear, to ovate-lanceolate, 1.5–2 mm, pubescent outside and inside above middle. Corolla light blue, campanulate-rotate; tube 1.5–1.8 mm; appendages lunate, with a small papillate emergence; limb ca. 5 mm wide; lobes ovate to suborbicular, 2–2.5 mm. Anthers ovate to elliptic, ca. 0.5 mm. Style ca. 0.6 mm, not surpassing nutlets. Nutlets dorsiventrally compressed, sparsely pubescent, 1.5–1.7 × ca. 1 mm excluding marginal glochids, adaxially protruding, abaxially somewhat convex; marginal glochids fewer, free or nearly so at base; attachment scar below middle adaxially. Fl. and fr. Jul-Aug.

• Rocky slopes; 4500–4600 m. Xizang.

**18. *Eritrichium deqinense*** W. T. Wang, Bull. Bot. Res., Harbin 6(3): 94. 1986.

德钦齿缘草 de qin chi yuan cao

Herbs perennial, cushionlike, small, 5–8 cm in diam., 2.5–3.5 cm tall. Rhizomes much branched. Stems numerous, 2–3 cm, densely strigose. Basal leaves densely rosulate, ca. as long as to longer than marginally long ciliate petiole, with sheath, oblong to broadly linear, 7–10 × 2.2–2.8 mm, papery, adaxially strigose, stiff short bristly, tuberculate, base tapering toward petiole, apex obtuse; midvein prominent abaxially, lateral veins indistinct. Cymes ca. 1 cm, usually 3-flowered, axis strigose; bracts oblanceolate to linear, 3–5 mm. Pedicel strigose, 6–8 mm. Calyx lobes linear, ca. 2 mm, strigose, united at base. Corolla white, ca. 5 mm wide, glabrous; tube ca. 1.5 mm, faucal appendages lunate; lobes 5, suborbicular. Anthers broadly ovoid, ca. 0.3 mm. Pistil ca. 1 mm. Nutlets 4, white pubescent, dorsiventrally compressed; adaxially convex, pubescent, keeled above attachment scar; abaxially broadly ovate, nearly flat, ca. 1.8 × 1.1 mm; marginal glochids 6 or 7 on each side, nearly free at base, white, narrowly triangular, 0.3–0.9 mm, margin sparsely ciliate; attachment scar above middle adaxially. Fl. and fr. Jul.

• On rocks of mountain slopes; ca. 4000 m. Yunnan.

**19. *Eritrichium pectinatociliatum*** Y. S. Lian & J. Q. Wang

in W. T. Wang, Y. S. Lian, & J. Q. Wang, Acta Phytotax. Sin. 18: 518. 1980.

篦毛齿缘草 bi mao chi yuan cao

Herbs perennial, cushionlike, 3–7 cm tall. Stems cespitose, not branched, densely appressed pubescent, frequently with persistent withered basal leaves and leaf bases. Basal leaves long petiolate; leaf blade spatulate, (6–)10–15 × 3–4 mm, appressed white pubescent, base attenuate, apex rounded. Lower inflorescences axillary or extra-axillary, 1-flowered; upper inflorescences 3- to several flowered. Pedicel sparsely pubescent, 2–5 mm; pedicel of single flowers to 1.2 cm. Calyx lobes erect at anthesis, ascending to divaricate, lanceolate to elliptic-lanceolate, ca. 1.5 mm, densely appressed pubescent outside, glabrous or nearly so inside. Corolla purple or light blue, campanulate-rotate; tube ca. 1.2 mm; appendages transversely oblong, papillose; limb ca. 5 mm wide; lobes suborbicular, ca. 2 mm wide. Anthers suborbicular, 0.3–0.4 mm. Gynobase flat, slightly raised in fruit becoming low fastigiata. Style ca. 0.5 mm. Nutlets dorsiventrally compressed, ca. 1 mm; adaxially protruding, glabrous; abaxially ovate, sparsely pubescent, margin hispid, with pectinate bristles or occasionally glochids; attachment scar at middle or slightly above middle adaxially. Fl. and fr. Jun-Aug.

• Slopes; 4100–4900 m. Qinghai (Zhidoi Xian), Xizang (Amdo Xian).

**20. *Eritrichium angustifolium*** Y. S. Lian & J. Q. Wang in W. T. Wang, Y. S. Lian, & J. Q. Wang, Acta Phytotax. Sin. 18: 516. 1980.

狭叶齿缘草 xia ye chi yuan cao

Herbs perennial, cushionlike, 6–10 mm tall. Stems cespitose, pilose, with persistent withered leaves and leaf bases. Petiole of basal leaves 1–2.5 cm; leaf blade narrowly elliptic, 5–15 × 3–5 cm, spreading white pilose, apex short acuminate; stem leaves sessile. Inflorescences axillary or extra-axillary, 1-flowered; upper inflorescences 3–5-flowered. Pedicel 3–5 mm. Calyx lobes erect to ascending, linear to narrowly elliptic, 2–2.5 × ca. 1 mm, with appressed and numerous long ciliate hairs along margin. Corolla blue, campanulate-rotate; tube ca. 2 mm; appendages cordate; limb ca. 6 mm wide; lobes elliptic, ca. 2.5 mm. Stamens inserted below middle in corolla tube; anthers suborbicular, ca. 0.5 mm. Nutlets dorsiventrally compressed, ca. 2 × 1 mm excluding marginal prickles, adaxially keeled; abaxially ovate, sparsely pubescent, marginal rib narrowly winged, wings with unequal prickles along margin, prickles not barbed; attachment scar at middle adaxially. Fl. and fr. Jun-Aug.

• Ridges, on rocks. Xizang.

**21. *Eritrichium humillimum*** W. T. Wang in W. T. Wang, Y. S. Lian, & J. Q. Wang, Bull. Bot. Lab. N. E. Forest. Inst., Harbin 9: 44. 1980.

矮齿缘草 ai chi yuan cao

Herbs perennial, cushionlike, 2–4 cm tall. Stems usually

surpassing cushion, sparsely short appressed pubescent. Petiole of basal leaves 1–2 cm; leaf blade oblong to long elliptic, 3–12 × 2–4 mm, abaxially glabrous or nearly so, adaxially sparsely appressed pubescent; stem leaves 1 or 2. Inflorescences racemose, 1–1.5 cm, 2–5-flowered. Pedicel 3–7 mm, short appressed pubescent. Calyx lobes lanceolate-linear, 1.5–2 mm, appressed pubescent outside, subglabrous inside. Corolla light purple, campanulate-rotate; tube ca. 1.2 mm; appendages transversely oblong, 0.5–0.7 mm, surpassing throat; limb ca. 5 mm wide; lobes obovate to suborbicular, ca. 2 mm. Anthers elliptic, ca. 0.5 mm. Nutlets dorsiventrally compressed, ca. 2 × 1 mm excluding marginal prickles, adaxially keeled, glabrous; abaxially slightly convex, ovate-triangular, sparsely pubescent or glabrous, margin with a glabrous or sparsely pubescent, erose, membranous wing; attachment scar at middle or slightly above adaxially. Fl. and fr. Jul-Aug.

• Sand, rock piles, sunny foothills; 3400–4900 m. Gansu (Tianzhu Xian), Qinghai (Zhidoi Xian).

**22. *Eritrichium lasiocarpum*** W. T. Wang in W. T. Wang, Y. S. Lian, & J. Q. Wang, Acta Phytotax. Sin. 18: 517. 1980.

毛果齿缘草 mao guo chi yuan cao

Herbs perennial, 5–10 cm tall. Stems erect, ascending or prostrate, appressed pubescent. Petiole of basal leaves 1–2.5 cm; leaf blade oblanceolate, 0.7–1.5 cm × 2–5 mm, appressed white pubescent, base attenuate, apex obtuse to acute; stem leaves short petiolate or sessile, smaller. Inflorescences extra-axillary, racemose, 2–4 cm, 3–10-flowered; bracts resembling leaves, sharply reduced upward to absent. Pedicel thin, weak, appressed pubescent. Calyx lobes lanceolate to narrowly oblong, 1–1.5 mm, appressed pubescent outside, glabrous or sparsely pubescent inside. Corolla light blue, campanulate-tubular; tube 1–1.2 mm; appendages fleshy, 2-cleft; lobes orbicular or nearly so, 0.5–1.3 mm. Stamens inserted below middle of corolla tube; anthers suborbicular. Nutlets dorsiventrally compressed, 1–1.2 × ca. 1 mm excluding marginal glochids, adaxially sparsely short pubescent; abaxially triangular-ovate, slightly convex, densely and minutely hispid, marginal glochids ca. 0.4 mm, triangular below middle, free or confluent into a narrow wing; attachment scar above middle adaxially. Fl. and fr. Jul-Aug.

• Rocky slopes and crevices; 4600–4900 m. Xizang.

**23. *Eritrichium qofengense*** Y. S. Lian & J. Q. Wang in W. T. Wang, Y. S. Lian, & J. Q. Wang, Acta Phytotax. Sin. 18: 518. 1980.

珠峰齿缘草 zhu feng chi yuan cao

Herbs perennial, cushionlike, 2–5 cm tall. Stems slightly surpassing leaf cluster, pilose. Leaves basal; petiole 1–1.5 cm; leaf blade oblong to broadly elliptic or obovate, 3–6 × 2–4 mm, spreading pilose, base broadly cuneate, apex obtuse to acute. Inflorescences terminal, 1–4-flowered; bracts leaflike. Pedicel 3–5 mm, pilose. Calyx lobes reflexed, lanceolate, ca. 2 mm in fruit, densely appressed pubescent outside, sparsely short appressed pubescent inside. Corolla

blue-purple, campanulate-tubular; tube ca. 1.2 mm; lobes obovate to short oblong, ca. 0.8 mm, with a partly sunken basal area outside, inside slightly convex becoming triangular to cordate. Stamens inserted on middle of corolla tube; anthers suborbicular, ca. 0.2 mm in diam. Gynobase nearly semiglobose, ca. 0.5 mm. Style shorter. Nutlets dorsiventrally compressed, ovate, 1.8–2 × ca. 1 mm excluding marginal glochids; adaxially protuberant, keeled; abaxially slightly convex, sparsely white hispid; marginal glochids shorter, confluent below middle into a broad wing, hispid; attachment scar above middle adaxially. Fl. and fr. Jun-Jul.

- Alpine meadows, rock crevices; 5400–5500 m. Xizang.

**24. *Eritrichium heterocarpum*** Y. S. Lian & J. Q. Wang in W. T. Wang, Y. S. Lian, & J. Q. Wang, Bull. Bot. Lab. N. E. Forest. Inst., Harbin 9: 45. 1980.

异果齿缘草 yi guo chi yuan cao

Herbs annual or biennial, 15–40 cm tall. Stems erect, branched from base, densely white strigose. Leaf blade linear-oblong, 1–2.5 cm × 3–7 mm, appressed pubescent, base broadly cuneate, apex obtuse. Inflorescences terminal, to 10 cm after anthesis, widely spaced, 10–20-flowered; bracts leaflike. Pedicel 2–5 mm, with ascending or slightly recurved short hairs. Calyx lobes erect at anthesis, divaricate in fruit, ovate to ovate-lanceolate, ca. 1.5 mm, appressed pubescent. Corolla blue, campanulate-rotate; tube 1.1–1.3 mm; appendages nearly semiorbicular, slightly surpassing throat, ca. 0.2 mm, with a papillate emergence below; lobes oblong to obovate, 1.1–1.3 mm. Stamens on lower part in corolla tube; anthers ovate-orbicular. Nutlets heteromorphic, dorsiventrally compressed, ca. 2 × 1–1.2 mm excluding marginal glochids; marginal glochids confluent into wings; attachment scar at middle adaxially. Broadly winged nutlets larger, glabrous or only sparsely pubescent; narrowly winged nutlets smaller, densely hispid, marginal glochids present. Fl. and fr. Jul-Aug.

- Slopes, hillside thickets; ca. 3200 m. Qinghai (Tongren Xian), Yunnan (Zhongdian Xian).

**25. *Eritrichium echinocaryum*** (I. M. Johnston) Y. S. Lian & J. Q. Wang in W. T. Wang, Y. S. Lian, & J. Q. Wang, Bull. Bot. Lab. N. E. Forest. Inst., Harbin 9: 46. 1980.

云南齿缘草 yun nan chi yuan cao

*Hackelia echinocarya* I. M. Johnston, J. Arnold Arbor. 21: 54. 1940.

Herbs annual, 30–40 cm tall. Stems erect or ascending, much branched, long strigose. Leaves short petiolate or ± sessile, oblanceolate to linear-oblong, 2–4 cm × 3–6 mm, short strigose, base broadly cuneate to cuneate, apex obtuse to acute; midvein marked. Inflorescences terminal, widely spaced, to 10–15 cm in fruit, becoming racemelike; lower flowers with leaflike bracts. Pedicel 1–7 mm, sparsely pubescent, erect to ascending, recurved to arcuate in fruit. Calyx lobes erect at anthesis, divaricate in fruit, oblong-linear, 2–2.5 mm, appressed pubescent outside, subglabrous inside.

Corolla yellow-green, campanulate-tubular, 1.5–2 mm; appendages low trapeziform, sparsely pubescent; lobes suborbicular, ca. 1 mm wide. Anthers suborbicular. Style ca. 0.5 mm. Nutlets dorsiventrally compressed, 2.2–1.5 × 1.5–1.8 mm excluding marginal glochids; adaxially protruding, ribbed; abaxially ovate, flat, with center line rib, with many fine tubercles and bristles; marginal glochids lanceolate, 1–1.5 mm, base slightly confluent, margin ciliate; attachment scar slightly above middle adaxially, ovate. Fl. and fr. Jun-Jul.

- Open slopes; ca. 2700 m. Yunnan (Dêqên Xian).

**26. *Eritrichium thymifolium*** (A. de Candolle) Y. S. Lian & J. Q. Wang in W. T. Wang, Y. S. Lian, & J. Q. Wang, Bull. Bot. Lab. N. E. Forest. Inst., Harbin 9: 46. 1980.

假鹤虱齿缘草 jia he shi chi yuan cao

Herbs annual, 10–35 cm tall. Stems much branched, appressed pubescent. Basal leaves becoming withered, spatulate to oblanceolate, 1–3 cm × 3–4 mm; stem leaves short petiolate or sessile, linear, 1–3 cm × 2–3 mm, appressed pubescent, base cuneate, apex obtuse. Inflorescences terminal, frequently extra-axillary, several to many flowered, becoming racemelike. Pedicel 2–5 mm, sparsely pubescent, erect to ascending at anthesis, recurved in fruit. Calyx lobes erect at anthesis, divaricate or reflexed in fruit, linear-lanceolate to lanceolate-oblong, ca. 2 mm, appressed pubescent outside, glabrous or sparsely appressed pubescent inside. Corolla blue or light blue, campanulate-tubular, ca. 1.3 mm; appendages smaller, papillate; lobes oblong, ca. 0.7 mm. Anthers ovate-triangular, ca. 0.3 mm. Nutlets dorsiventrally compressed, glabrous or sparsely pubescent, 1.5–2.5 × ca. 1 mm excluding marginal glochids, adaxially keeled, abaxially slightly convex; marginal glochids ca. 1 mm, triangular below, free or confluent into a wing; attachment scar at middle or slightly below adaxially, ovate. Fl. and fr. Jun-Aug.

Sunny slopes, gravelly areas, terraces; 1800–4800 m. Gansu, Heilongjiang, Nei Mongol, Ningxia, Xinjiang, Xizang [India, Japan, Kazakhstan, Mongolia, Russia].

- 1a. Plants 10–35 cm; nutlets ca. 1.5 mm excluding marginal glochids, marginal glochids free ..... 26a. subsp. *thymifolium*
- 1b. Plants less than 20 cm; nutlets ca. 2.5 mm excluding marginal glochids, marginal glochids confluent into a broad wing ..... 26b. subsp. *latialatum*

**26a. *Eritrichium thymifolium*** subsp. *thymifolium*

假鹤虱齿缘草(原变种) jia he shi chi yuan cao (yuan bian zhong)

*Echinosperrum thymifolium* A. de Candolle, Prodr. 10: 136. 1846; *E. deflexum* Lehmann var. *pumilum* Ledebour; *Hackelia thymifolia* (A. de Candolle) I. M. Johnston; *Lappula thymifolia* (A. de Candolle) Gürke.

Plants 10–35 cm tall. Nutlets ca. 1.5 mm excluding marginal glochids, marginal glochids free.

Sunny slopes, gravelly areas; ca. 1800 m. Gansu, Heilongjiang, Nei Mongol, Ningxia, Xinjiang [N India, Japan, Kazakhstan, Mongolia, Russia].

**26b. *Eritrichium thymifolium* subsp. *latialatum*** Y. S. Lian & J. Q. Wang in W. T. Wang, Y. S. Lian, & J. Q. Wang, *Acta Phytotax. Sin.* 18: 519. 1980.

宽翅 齿缘草 kuan chi chi yuan cao

Plants less than 20 cm tall. Nutlets ca. 2.5 mm excluding marginal glochids, marginal glochids confluent into a broad wing.

- Gravelly slopes and terraces; ca. 4800 m. Xizang.

**27. *Eritrichium acicularum*** Y. S. Lian & J. Q. Wang in W. T. Wang, Y. S. Lian, & J. Q. Wang, *Bull. Bot. Lab. N. E. Forest. Inst., Harbin* 9: 46. 1980.

针刺齿缘草 zhen ci chi yuan cao

Herbs annual or biennial, 15–30 cm tall. Stems erect, much branched, with spreading short hairs. Basal leaves becoming withered, petiolate, spatulate to oblanceolate; stem leaves sessile, oblanceolate-linear to linear, 1–3.5 cm × 2–4 mm, finely appressed pubescent, base cuneate, apex obtuse. Inflorescences racemose; bracts leaflike. Pedicel 3–10 mm, sparsely pubescent, erect at anthesis, ascending to slightly curved in fruit. Flowers widely spaced. Calyx lobes erect at anthesis, mostly divaricate in fruit, ovate to ovate-oblong, 1–2.5 mm, appressed pubescent outside, sparsely short pubescent inside. Corolla blue, campanulate-tubular; tube 1–1.2 mm; appendages lunate; lobes ovate to suborbicular, 1–1.2 mm. Anthers ovate. Gynobase low fastigiate, 0.5–0.7 mm. Nutlets dorsiventrally compressed, sparsely pubescent, 2–2.5 × ca. 1 mm excluding marginal glochids, adaxially protruding; abaxially slightly convex, finely tuberculate; marginal glochids needlelike, with separate bases; attachment scar at middle adaxially.

- Ravines, slopes, marshes; 2200–2400 m. Gansu, Qinghai (Huangyuan Xian).

**28. *Eritrichium tangkulaense*** W. T. Wang in W. T. Wang, Y. S. Lian, & J. Q. Wang, *Acta Phytotax. Sin.* 18: 519. 1980.

唐古拉齿缘草 tang gu la chi yuan cao

Herbs annual or biennial, 5–15 cm tall. Stems several, cespitose, often branched from base, short appressed pubescent. Basal leaves frequently withered after anthesis, oblanceolate-spatulate, 1–2 cm × 2–8 mm, short appressed pubescent, base attenuate into petiole, apex obtuse; stem leaves sessile, ovate-oblong, 0.8–1.2 cm × 2–4 mm. Inflorescences racemelike, 5–10-flowered; bracts 1–3 below, leaflike, sharply reduced to absent above. Pedicel erect at anthesis, mostly ascending in fruit, 3–5 mm, short appressed pubescent. Calyx lobes erect at anthesis, divaricate in fruit, linear-oblong to oblong, 1–2 mm, densely appressed pubescent outside, sparsely appressed pubescent inside at apex. Corolla light blue, light purple, or white, campanulate-tubular; tube ca. 2 × as long as lobes; appendages obscure; lobes suborbicular, 0.5–0.7 mm. Anthers ovate, 0.2–0.3 mm. Gynobase ca. 0.5 mm. Nutlets dorsiventrally compressed, sparsely pubescent or subglabrous, 1–1.2 × ca. 0.8 mm

excluding marginal glochids; adaxially keeled on center line, becoming winged above attachment scar; disc flat or slightly convex; marginal glochids lanceolate-triangular, confluent into a broad wing; attachment scar below middle adaxially, ovate. Fl. and fr. Jul-Sep.

- Hillsides, roadsides, sandy and gravelly areas, rivers, rocky crevices; 3500–4900 m. Gansu (Jiuquan Xian), Xinjiang, Xizang (Amdo Xian).

**29. *Eritrichium axillare*** W. T. Wang in W. T. Wang, Y. S. Lian, & J. Q. Wang, *Acta Phytotax. Sin.* 18: 519. 1980.

腋花齿缘草 ye hua chi yuan cao

Herbs annual, diffuse. Stems prostrate, 5–13 cm tall, ca. 1 mm in diam., densely appressed pubescent. Leaves ± sessile, lanceolate-oblong to ovate-oblong, 0.6–1.5 cm × 3–5 mm, appressed pubescent, base broadly cuneate to suborbicular, apex obtuse to acute. Inflorescences axillary or extra-axillary. Pedicel 2–4 mm, appressed pubescent. Calyx lobes ovate to obovate-lanceolate, 2–3 mm, appressed pubescent outside, glabrous or only apex slightly appressed pubescent inside. Corolla white, campanulate-tubular; tube ca. 1 mm; appendages transverse linear; lobes short oblong, ca. 0.7 mm. Stamens inserted on middle of corolla tube; anthers oblong, ca. 0.3 mm. Gynobase low fastigiate, ca. 0.8 mm, with 2 or 3 semiorbicular ears. Nutlets dorsiventrally compressed, sparsely pubescent, 2.4–2.8 × 1.5–1.8 mm excluding marginal glochids, adaxially protruding; abaxially triangular-ovate, flat or slightly convex; marginal glochids lanceolate, 1–1.8 mm, sparsely pubescent, bases nearly free or slightly confluent into a narrow wing; attachment scar at middle or slightly below adaxially. Fl. and fr. Aug-Sep.

- Slopes; 4500–4800 m. Xizang (Biru Xian).

**30. *Eritrichium spathulatum*** (Benth) C. B. Clarke in J. D. Hooker, *Fl. Brit. India* 4: 164. 1883.

匙叶齿缘草 chi ye chi yuan cao

*Echinosperrum spathulatum* Benth in Royle, *Ill. Bot. Himal. Mts.* 306. 1836; *Eritrichium jacquemontii* Decaisne; *E. rupestre* (Pallas) Bunge var. *pectinatum* (Pallas) Brand subvar. *spathulatum* (Benth) Brand.

Herbs perennial, 15–25 cm tall. Stems cespitose, often decumbent, short branched above or not, sparsely short appressed pubescent. Petiole of basal leaves 1–2 cm; leaf blade spatulate, 2–3 cm × 3–7 mm, abaxially densely short appressed pubescent, adaxially glabrous or pilose, base attenuate, apex obtuse; stem leaves sessile, spatulate to oblanceolate. Inflorescences terminal, several flowered, branches 2–3 cm, bracteate. Pedicel to 6 mm, sparsely pubescent. Calyx lobes oblong to ovate, ca. 1.5 mm, appressed pubescent outside, subglabrous inside. Corolla blue, campanulate-rotate; tube ca. as long as calyx lobes; appendages papillate; limb ca. 7 mm wide; lobes suborbicular, 2–2.5 mm wide. Gynobase fastigiate, 4-angled. Nutlets subturbinate, glabrous or somewhat pubescent, 2–3.5 × 1.3–2.5 mm excluding marginal glochids; marginal glochids ca. 0.6 mm, free; attachment scar small. Fl. and fr. Jun-Aug.

- Hillside meadows; 3600–3700 m. SE and W Xizang [N India, Pakistan].

**31. *Eritrichium fruticosum*** Klotzsch, Bot. Ergebn. Reise Waldemar 96. 1862.

小灌齿缘草 xiao guan chi yuan cao

*Eritrichium strictum* Decaisne var. *fruticosum* (Klotzsch) C. B. Clarke.

Herbs perennial, 10–30 cm tall. Stems cespitose, erect to decumbent, short branched above or not, sparsely appressed white pubescent. Petiole of basal leaves 1–2 cm; leaf blade ovate-lanceolate, ca. 2.5 cm × 5 mm, appressed pubescent, base attenuate, apex obtuse; stem leaves ± sessile or short petiolate. Inflorescences terminal, forked, 10–15-flowered, becoming racemose, bracteate. Pedicel ± curved in fruit, to 6 mm, pubescent. Calyx lobes erect at anthesis, spreading or slightly reflexed, lanceolate to linear, 1–1.5 mm, to 2.5 mm, pubescent. Corolla light blue, campanulate-rotate; tube ca. as long as calyx; appendages trapeziform, ca. 1 mm, with a papillate emergence inside; lobes suborbicular, 1.5–2.5 mm wide. Anthers oblong, ca. 1 mm. Nutlets subturbinate, minutely hispid, 1.7–2 × 0.8–1 mm excluding marginal glochids; abaxially slightly convex, base rounded, apex acute; marginal glochids ca. 0.5 mm, free. Fl. and fr. Jun–Aug.

Sandy river banks; ca. 4200 m. Xizang (Nyalam Xian) [N India, Pakistan].

**32. *Eritrichium canum*** (Benth) Kitamura, Acta Phytotax. Geobot. 19: 103. 1963.

灰毛齿缘草 hui mao chi yuan cao

*Echinosperrum canum* Benth in Royle, Ill. Bot. Himal. Mts. 1: 306. 1836; *Eritrichium strictum* Decaisne; *E. strictum* var. *thomsonii* C. B. Clarke.

Herbs perennial, 15–40 cm tall. Stems erect or decumbent, frequently woody at base, not branched or short branched above, densely appressed white sericeous. Petiole of basal leaves to 5 cm, pubescent; leaf blade narrowly lanceolate, to 8 cm × 6 mm, densely white sericeous, base broadly cuneate, apex acute to acuminate; stem leaves 1 to several below inflorescences, sessile, lanceolate to ovate-lanceolate, reduced upward. Inflorescences 2 or 3, forked, many flowered, corymbose at anthesis, becoming racemelike, to 15 cm after anthesis; bracts linear. Pedicel erect, 1–1.5 cm in fruit, short pubescent. Calyx lobes ovate, 1–2 mm, appressed pubescent, apex obtuse. Corolla light blue, campanulate-rotate; tube shorter; throat yellow or orange; appendages trapeziform or low trapeziform; lobes suborbicular, ca. 3 mm wide. Nutlets subturbinate, ca. 2 × 1.5 mm excluding marginal glochids; marginal glochids ca. 1 mm, confluent at base adaxially, glabrous or short pubescent or tuberculate; abaxially flat or slightly convex, sparsely pubescent; attachment scar at base adaxially. Fl. and fr. Jun–Jul.  $2n = 24$ .

Gravelly slopes, sandy river banks and marshes; 2700–5600 m. Xinjiang (Yecheng Xian), Xizang [Afghanistan, N India, Kashmir, Nepal, Pakistan].

**33. *Eritrichium gracile*** W. T. Wang in W. T. Wang, Y. S. Lian, & J. Q. Wang, Acta Phytotax. Sin. 18: 520. 1980.

条叶齿缘草 tiao ye chi yuan cao

Herbs perennial, 15–25 cm tall. Stems cespitose, erect, not branched, 1–1.5 mm in diam., densely appressed pubescent, frequently woody below, with persistent withered branches and leaves at base. Basal leaves petiolate, linear, ca. 2 cm × 2–4 mm, densely appressed pubescent; stem leaves sessile, linear, 2–4 cm. Inflorescences 2 or 3, forked or not, terminal, elongated, many flowered, becoming racemose in fruit. Pedicel 3–5 mm, sparsely pubescent, erect at anthesis, ascending or slightly curved. Flowers crowded. Calyx lobes erect or spreading, lanceolate-linear, 1.5–2 mm, densely appressed white pubescent outside, glabrous, or sparsely appressed pubescent. Corolla light blue, campanulate-rotate; tube 1.5–2 mm; appendages low trapeziform, papillose; lobes subobovate, ca. 2 × 1.5 mm. Nutlets turbinate, ca. 1 mm; disc flat or slightly convex, glabrous or finely tuberculate on lateral surfaces; marginal bristles curved toward center, lanceolate-triangular, free or nearly so at base, barbed; attachment scar at base adaxially. Fl. and fr. Jun–Jul.

• Gravelly areas; ca. 4600 m. Xizang (Zanda Xian).

**34. *Eritrichium incanum*** (Turczaninow) A. de Candolle, Prodr. 10: 127. 1846.

钝叶齿缘草 dun ye chi yuan cao

*Myosotis incana* Turczaninow, Mém. Soc. Imp. Naturalistes Moscou 11: 97. 1838.

Herbs perennial or biennial, 20–40 cm tall. Stems erect, several and cespitose, 1–3 with dense leaf clusters forming rosettes at base. Basal leaves spatulate to spatulate-lanceolate, 2–7 × 0.2–2 cm, gray-white spreading strigose and sericeous, hairs discoid at base, base attenuate, margin ciliate, apex acute to obtuse; stem leaves linear to narrowly oblanceolate. Inflorescences terminal, several to many flowered, becoming racemelike, to 6–15 cm after anthesis; bracts leaflike. Pedicel 1–2 cm, erect, pubescent. Flowers widely spaced. Calyx lobes linear to linear-lanceolate, 2–3 mm, sericeous, spreading hispid outside, short appressed pubescent. Corolla blue, campanulate-rotate; tube 2.5–3 mm; appendages lunate to low trapeziform, surpassing throat, with a papillate emergence below; lobes divaricate, suborbicular, 2.5–3 mm. Anthers narrowly ovate, ca. 1 mm. Gynobase 0.5–0.8 mm. Nutlets turbinate, smooth, shiny, ca. 2 × 1–1.2 mm excluding marginal prickles, abaxially flat or slightly convex, marginal rib irregularly finely prickled; prickles not barbed at apex; attachment scar at base. Fl. and fr. Jul–Aug.

Hillsides, gravelly places. Heilongjiang (Da Hingan Ling), Nei Mongol (Humeng Xian) [Korea, E Russia].

**35. *Eritrichium borealisinense*** Kitagawa, J. Jap. Bot. 38: 301. 1963.

北齿缘草 bei chi yuan cao

*Eritrichium jeholense* Baranov & Skvortzov.

Herbs perennial, 15–40 cm tall. Roots to 1 cm in diam. Stems several, cespitose, frequently forming a dense cluster. Basal leaves oblanceolate, 3–8 cm × 3–8 mm, with 2

different-sized strigose hairs, base cuneate, apex acute; stem leaves oblanceolate to lanceolate, 1.5–3 cm × 3–8 mm. Inflorescences extra-axillary, with 2–4 branches, 1–2 cm, to 2–10 cm in fruit, each branch several to many flowered; bracts linear-lanceolate, 3–5 mm. Pedicel 2–7 cm, erect to slightly ascending, with appressed white hairs. Calyx lobes erect at anthesis, mostly spreading in fruit, oblong-lanceolate to oblong-linear, 3.5–4 × 1–1.5 mm, strigose, apex acuminate to acute. Corolla blue, campanulate-rotate; tube 1.2–1.5 mm; appendages lunate to low trapeziform, surpassing throat; lobes obovate to orbicular, 3–3.5 mm. Anthers oblong. Nutlets turbinate, ca. 2.5 × 1 mm excluding marginal glochids; adaxially sca-brous, keeled; abaxially ovate to broadly ovate, slightly convex, with many fine tubercles and bristles, center line ribbed; marginal glochids triangular, confluent or nearly free, sparsely pubescent; attachment scar at middle or below adaxially, triangular. Fl. and fr. Jul-Sep.

• Hillside meadows, rocky crevices, thickets, rocky slopes. Hebei, Liaoning, Nei Mongol (Humeng Xian), Shanxi.

**36. *Eritrichium pauciflorum*** (Ledebour) de Candolle in A. de Candolle, Prodr. 10: 127. 1846.

少花齿缘草 shao hua chi yuan cao

*Myosotis pauciflora* Ledebour, Mém. Acad. Imp. Sci. Saint Pétersbourg Hist. Acad. 5: 517. 1812; *Eritrichium altaicum* Popov; *E. pulviniforme* Popov; *E. rupestre* (Pallas ex Georgi) Bunge; *E. subrupestre* Popov; *M. rupestris* Pallas ex Georgi.

Herbs perennial, 10–30 cm tall, densely gray sericeous. Stems several, base short branched with basally persistent withered leaves, frequently forming a dense cluster. Basal leaves spatulate to spatulate-ob lanceolate, 3–6 cm × 2–5 mm, base attenuate becoming stipelike, apex acute to obtuse; stem leaves narrowly oblanceolate to linear, 1–2 cm × 2–4 mm. Inflorescences terminal and extra-axillary, 1–2 cm, to 6 cm after anthesis, with 2–4 branches, each branch several to numerous flowered; bracts linear-lanceolate, 3–9 mm. Pedicel erect to slightly ascending, 3–5 mm, short appressed pubescent. Calyx lobes erect at anthesis, spreading in fruit, linear to oblanceolate, ca. 3.5 mm, apex acute to obtuse. Corolla blue, campanulate-rotate; tube ca. 2 mm; appendages lunate to low trapeziform, short pilose, surpassing throat, with a papillate emergence below; limb 6.5–8 mm wide; lobes elliptic to orbicular, ca. 4 mm. Anthers elliptic. Nutlets turbinate, ca. 2 × 1 mm, tuberculate and pubescent, abaxially flat or slightly convex; marginal glochids triangular, sometimes not barbed; attachment scar at base, broadly ovate. Fl. and fr. Jul-Aug.

Rocky slopes, gravelly areas, roadsides; 1400–2000 m. Gansu, Hebei, Nei Mongol, Ningxia, Shanxi [Kazakhstan, Mongolia, Russia].

**37. *Eritrichium mandshuricum*** Popov in Komarov, Fl. URSS 19: 711. 1953.

东北齿缘草 dong bei chi yuan cao

Herbs perennial, 15–30 cm tall. Stems branched from base and becoming cespitose, erect to subdecumbent. Leaf blade linear to subfiliform, 3–6 × ca. 1 cm, with many appressed white hairs. Inflorescences terminal, to 10 cm, racemelike, many flowered; bracts numerous, leaflike. Pedicel erect to slightly ascending, 5–10 mm, short appressed pubescent. Calyx lobes erect or slightly spreading, linear-ob lanceolate, 2–2.5 mm, slightly elongated in fruit, short appressed pubescent. Corolla light blue, campanulate-rotate; tube 1.5–2.5 mm; appendages lunate to low trapeziform, short pilose, slightly surpassing throat, with a papillate emergence; lobes suborbicular, 2.5–3.5 × 2.5–3 mm. Anthers oblong, ca. 0.8 mm. Nutlets dorsiventrally compressed, ca. 2 × 1 mm; adaxially keeled, slightly convex, glabrous, finely tuberculate, with a center line rib, marginal rib without prickles or glochids, rarely with a few fine teeth; attachment scar at lower part or base adaxially, oblong.

Hillside meadows, gravelly slopes, arid areas at high elevations. NE Hebei, Heilongjiang, Nei Mongol [Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan].

**38. *Eritrichium villosum*** (Ledebour) Bunge, Verz. Altai Pfl. 14. 1836.

长毛齿缘草 chang mao chi yuan cao

*Myosotis villosa* Ledebour, Mém. Acad. Imp. Sci. Saint Pétersbourg Hist. Acad. 5: 516. 1815; *Echinosperrum sericeum* Benth; *Eritrichium basifixum* C. B. Clarke; *E. nanum* (Villars) Schrader subsp. *villosum* (Ledebour) Brand; *E. nanum* subsp. *villosum* (Ledebour) Brand var. *euvillosum* Brand; *E. sericeum* (Benth) A. de Candolle.

Herbs perennial, 5–18 cm tall. Stems single or several and cespitose, pilose. Basal leaves forming a rosette, sessile, oblong to broadly lanceolate or oblanceolate. Inflorescences terminal, several to many flowered, becoming racemelike in fruit, 3–4 cm; bracts leaflike. Pedicel 1.5–3 mm, pilose. Calyx lobes erect or spreading, lanceolate to linear, ca. as long as pedicel, pilose outside, glabrous inside or nearly so. Corolla blue, light purple, rarely yellow, campanulate-rotate; tube 1.2–2 mm; appendages oblong, somewhat exerted from throat, with a papillate emergence below; lobes oblong, 1.8–2.5 mm. Stamens inserted on middle of corolla tube. Gynobase ca. 0.5 mm. Nutlets subturbinate, ca. 2 × 1.2–1.6 mm; abaxially slightly convex, somewhat pubescent, with a conspicuous center line rib; marginal bristles ca. 0.2–0.5 mm, pubescent and dentate, confluent into a narrow wing, not barbed; attachment scar at base, suborbicular. Fl. and fr. Jul-Aug.  $2n = 24$ .

Hillside meadows; 2500–3000 m. Heilongjiang, N Xinjiang, Xizang [Afghanistan, N India, Kashmir, Kazakhstan, Mongolia, Pakistan, Russia; N Europe].

**39. *Eritrichium hemisphaericum*** W. T. Wang in W. T. Wang, Y. S. Lian, & J. Q. Wang, Acta Phytotax. Sin. 18: 519. 1980.

半球齿缘草 ban qiu chi yuan cao

Herbs perennial, cushionlike, 1–3 cm tall. Stems numerous, in crowded fascicles. Petiole 1–1.5 cm, base

inflated becoming sheathlike; leaf blade spatulate to obovate-oblong, abaxially sparsely short pubescent only near apex, adaxially white pilose, base attenuate forming into a petiole, margin ciliate, apex obtuse. Inflorescences terminal, 1- or 2-flowered. Pedicel somewhat pubescent, 1–1.5 cm in fruit, mostly erect. Calyx lobes erect at anthesis, divaricate in fruit, rarely reflexed, ovate to broadly ovate, 0.7–1 mm, with many white hairs outside, glabrous inside and with many ciliate hairs along margin. Corolla blue, campanulate-tubular, ca. 2 mm; tube usually ca. 2 × as long as lobes; appendages obscure or papillate; lobes orbicular or nearly so, ca. 0.7 mm.

Stamens inserted at middle of corolla tube; anthers elliptic. Gynobase semiglobose, ca. 0.5 mm. Style ca. 0.5 mm. Nutlets dorsiventrally compressed, 1.2–1.5 × 0.8–1 mm excluding marginal glochids; adaxially keeled, glabrous; abaxially ovate, with a center line rib, with many hairs; marginal glochids curved toward center, confluent into a broad wing, margin irregularly bristly, tips not anchorlike; attachment scar at middle adaxially. Fl. and fr. Jul-Aug.

• Gravelly slopes, volcanic rock piles; 4900–5700 m. Qinghai (Zhidoi Xian), Xizang.

## 29. HACKELIA Opiz ex Berchtold, Oekon.-Techn. Fl. Bohmens. 2(2): 147. 1839.

假鹤虱属 jia he shi shu

Herbs perennial or annual, appressed strigose or villous, 20–100 cm tall. Leaves alternate, green, large, thin. Inflorescences rarely solitary, terminal, not branched or paniculate. Fruiting pedicel deflexed. Calyx 5-parted to base or nearly so; lobes enlarged in fruit, vertical to reflexed. Corolla blue, light blue, or light purple, rarely yellow or white, campanulate-rotate to campanulate-tubular; throat with appendages, rarely appendages obscure or absent; lobes 5, imbricate in bud, vertical or divaricate at anthesis. Stamens inserted on corolla, included; anthers orbicular, ovate to oblong. Style and stigma solitary, usually not exceeding nutlets. Gynobase short pyramidal, to 2–3 mm. Nutlets 4, all or some developed, turbinate to ovoid, triangular-ovoid and dorsally compressed, marginal rib with compressed triangular to lanceolate glochids.

About 45 species: mainly in temperate regions of the Northern Hemisphere, and Central and South America; three species in China.

Lian & Wang (Acta Phytotax. Sin. 18: 514–520. 1980; Fl. Reipubl. Popularis Sin. 64(2): 116–151. 1989) argued that the differences between *Eritrichium* and *Hackelia* are insufficient to keep them as separate genera. However, the gynobase in *Eritrichium* is cushion-shaped, to 1 mm high, while in *Hackelia* it is distinctly conical and 2–3 mm high. It is likely that other species from China listed under *Eritrichium* will need to be transferred to *Hackelia* in the future.

- 1a. Calyx lobes oval; corolla appendages long elliptic; style hidden, lower than nutlet ..... 1. *H. uncinatum*  
 1b. Calyx lobes oval-lanceolate to lanceolate; corolla appendages trapeziform; style not hidden, longer than nutlet.  
 2a. Calyx ca. as long as corolla tube; corolla 7–9 mm in diam.; appendages 1.6–2 × as long as wide; nutlets homomorphic ..... 2. *H. brachytuba*  
 2b. Calyx longer than corolla tube; corolla 9–12 mm in diam.; appendages 1–1.5 × as long as wide; nutlets heteromorphic ..... 3. *H. difformis*

**1. *Hackelia uncinatum*** (Benth) C. E. C. Fischer, Bull. Misc. Inform. Kew 1932: 298. 1932.

卵萼假鹤虱 luan e jia he shi

*Cynoglossum uncinatum* Benth in Royle, Ill. Bot. Himal. Mts. 1: 34. 1836; *C. laxum* G. Don; *C. roylei* Wallich ex G. Don; *Echinosperrum glochidiatum* A. de Candolle; *Eritrichium uncinatum* (Benth) Y. S. Lian & J. Q. Wang; *Hackelia glochidiata* (A. de Candolle) Brand; *H. roylei* (Wallich ex G. Don) I. M. Johnston; *Lappula glochidiata* (A. de Candolle) Brand; *Paracaryum glochidiatum* (A. de Candolle) Benth & J. D. Hooker.

Herbs perennial, 60–80(–100) cm high. Stems several, clustered, hollow, branched above, sparsely short pubescent. Petiole of basal leaves 25–30 cm; leaf blade ovate to wide ovate, 8–9 × 4–5 cm, short pubescent. Upper petioles of stem leaves shorter than below; leaf blade ovate to elliptic, 5–10 × 1.7–5 cm, pubescent, base cuneate or shallowly cordate or rounded; lateral veins 5–7. Inflorescences at apex of branches, 2-parted, 5–10(–15) cm; bracts absent or basal, 1 or 2 flowers bracteate. Pedicel thin, weak, 2–3(–4) mm, to 6–7 mm in fruit, minutely pubescent. Calyx lobes ovate, ca. 2 mm,

pubescent. Corolla blue or bluish purple, campanulate; tube ca. 2 mm, 5–7(–9) mm in diam.; limb ovate to elliptic, 3–3.5 mm; appendages long elliptic, minutely pubescent or not. Stamens at center of tube; anthers oval. Style shorter than nutlets. Nutlets tuberculate; marginal glochids 4–5 mm, glabrous, with 1–1.5(–2) mm barbs, bases confluent into a broad wing. Fl. and fr. Jun-Aug.

Wet slopes, forest understory, between grasslands; 2700–4500 m. S Xizang, NW Yunnan [Bhutan, India, Pakistan].

**2. *Hackelia brachytuba*** (Diels) I. M. Johnston, J. Arnold Arbor. 18: 25. 1937.

大叶假鹤虱 da ye jia he shi

*Paracaryum brachytubum* Diels, Notes Roy. Bot. Gard. Edinburgh 5: 168. 1912; *Eritrichium brachytubum* (Diels) Lian & J. Q. Wang; *Hackelia dielsii* (Brand) I. M. Johnston; *Lappula dielsii* Brand.

Herbs perennial, 40–70 cm. Stems many, branched, sparsely short pubescent. Petiole of basal leaves to 25 cm; leaf blade cordate, 5–10(–13) × 4–9 cm, sparsely short pubescent, base cordate, apex acuminate; lateral veins 5–9. Petiole of

stem leaves shorter; leaf blade ovate to narrowly ovate, 4–10 × 2–5 cm. Inflorescences at apex of stems or branches, 2-parted, 5–9 cm; bracts emarginate. Pedicel thin, long, 3–7 mm, short pubescent. Calyx triangular-lanceolate to linear-lanceolate, 3–3.5(–4) mm. Fruiting calyx enlarged, 6–7 mm, short pubescent outside. Corolla blue to light purple, campanulate; tube 3–3.5(–4) mm, 7–9 mm in diam.; limb ± rounded; appendages trapeziform, 1.8–2.1 × 0.6–1 mm, with curly soft hairs. Anthers rounded or oblong, 1–3 mm. Style higher than nutlet. Nutlets 4–4.5 × ca. 2 mm; adaxially slightly tuberculate, with few glochids or sparse minute hairs; marginal glochids 2–3 mm; abaxially tuberculate. Fl. and fr. Jul–Aug.

Slopes, forest understory; 2900–3800 m. S Gansu, Sichuan, S Xizang, NW Yunnan [Nepal].

**3. *Hackelia difformis*** (Y. S. Lian & J. Q. Wang) Riedl, *Novon* 4: 47. 1994.

异型假鹤虱 yi xing jia he shi

*Eritrichium difforme* Y. S. Lian & J. Q. Wang in W. T. Wang, Y. S. Lian, & J. Q. Wang, *Acta Phytotax. Sin.* 18: 515. 1980.

Herbs perennial, 30–120 cm tall. Stems hollow, sparsely short pubescent. Leaves attenuate to long petiole, (5–)8–9 × (2.5–)5–6 cm, sparsely short pubescent, base cordate, apex acuminate; stem leaves short or indistinctly petiolate, elliptic to ovate, 4–14 × 2–7 cm, base subrounded. Inflorescences bracteate at middle or slightly below. Pedicel thin, 5–10 mm, pubescent. Calyx erect at anthesis, deflexed at fruiting; lobes linear, pubescent outside. Corolla bluish purple, campanulate-tubular, ca. 3 × 9–12 mm; appendages ca. 1.5 mm, densely pubescent on margin; lobes ovate. Anthers oblong, ca. 1 mm. Nutlets unequal, 3 or 4 developed, ca. 4 × 3 mm, adaxially without hairs; abaxially tuberculate, with or without stiff bristles, sometimes marginal rib with few prickles. Fl. and fr. Jun–Jul.

• Roadsides, slopes, forests, river banks, wet rock crevices; 2300–3800 m. Sichuan, Xizang, Yunnan.

### 30. MICROULA Bentham in Bentham & J. D. Hooker, *Gen. Pl.* 2: 853. 1876.

微孔草属 wei kong cao shu

Herbs biennial, usually hispid or bristly, rarely pubescent. Roots terete. Stems erect to ascending, frequently branched from base, sometimes very short. Leaves alternate, margin entire, rarely with obscure teeth; lateral veins few, not conspicuous. Cymes short, crowded, rarely elongated, becoming spiciform or racemelike, sometimes 1-flowered at a branching point opposite a leaf; bracts obscure. Calyx 5-parted, slightly enlarged in fruit, subtending nutlets. Corolla blue or white, low salverform; throat 5-appendaged; appendages opposite lobes; limb 5-lobed, spreading horizontally. Stamens included. Ovary 4-parted. Style included; stigma compressed globose. Gynobase nearly flat or low fastigiata. Nutlets ovoid or long turbinate, slightly dorsiventrally, rarely slightly bilaterally compressed, or abaxial and adaxial surfaces extended and becoming long turbinate, usually tuberculate, glabrous or short pubescent, rarely with glochids, abaxially usually with an aperture, aperture margin 1- (or 2)-layered; attachment scar extending from base to apex adaxially.

Twenty-nine species: Bhutan, N and NE India, Nepal, Sikkim; all in China.

- 1a. Plants apparently almost stemless with a rosette of leaves flat on ground and a very dense central cluster of flowering branches; nutlets with glochids ..... 29. *M. tibetica*
- 1b. Plants with normal stems, stem leaves, and laxer inflorescences; nutlets without glochids.
  - 2a. Nutlets long turbinate, abaxial aperture orbicular, at apex of nutlets ..... 23. *M. turbinata*
  - 2b. Nutlets ovoid.
    - 3a. Abaxial aperture of nutlets deltate or triangular, with a membranous emergence inside margin, attachment scar at base adaxially.
      - 4a. Plants not bristly; corolla limb 5–8 mm wide, tube 2–4 mm; abaxial aperture of nutlets deltate, 0.7–1 mm.
        - 5a. Stems densely hispid; leaves and calyx hirsute; inflorescences short, crowded; pedicel ca. 1 mm ..... 24. *M. longituba*
        - 5b. Stems short strigose; leaves and calyx short strigose; inflorescences with many branches, widely spaced; pedicel 1–2.5 mm ..... 25. *M. floribunda*
      - 4b. Stems and leaves bristly; corolla limb 2–3 mm wide, tube 1–1.8 mm; abaxial aperture of nutlets triangular, 0.9–1.5 mm.
        - 6a. Leaf blade spatulate-linear to linear, 2–7 mm wide, abaxially with few bristles along midvein only ..... 26. *M. stenophylla*
        - 6b. Leaf blade narrowly oblong to oblanceolate, 5–15 mm wide, short strigose, abaxially with scattered bristles ..... 27. *M. diffusa*
    - 3b. Abaxial aperture of nutlets oblong, elliptic, to orbicular, without emergence inside margin, sometimes abaxial aperture absent.
      - 7a. Attachment scar of nutlet apical.
        - 8a. Stems 15–45 cm, bristly; bracts to 2 mm; abaxial aperture of nutlets frequently occupying entire abaxial surface ..... 22. *M. trichocarpa*

- 8b. Stems 3–7 cm, pubescent; bracts of inflorescences 3–8 × 3–6 mm; nutlets without abaxial aperture ..... 28. *M. tangutica*
- 7b. Attachment scar of nutlet basal to middle adaxially.
- 9a. Nutlets slightly bilaterally compressed, without abaxial aperture ..... 21. *M. efoveolata*
- 9b. Nutlets ± dorsiventrally compressed, with abaxial aperture.
- 10a. Nutlets glabrous, slightly shiny, black spotted ..... 20. *M. leiocarpa*
- 10b. Nutlets tuberculate or wrinkled.
- 11a. Stems bristly.
- 12a. Basal and lower stem leaves with base rounded to broadly cuneate, abruptly constricted into a petiole.
- 13a. Corolla limb 5–9(–11) mm wide ..... 8. *M. sikkimensis*
- 13b. Corolla limb ca. 2.5 mm wide ..... 9. *M. blepharolepis*
- 12b. Basal and lower stem leaves with base attenuate to cuneate.
- 14a. Corolla limb pubescent outside; nutlets ca. 3 mm, abaxial aperture ca. 2.2 mm ..... 7. *M. forrestii*
- 14b. Corolla limb glabrous outside; nutlets less than 2.6 mm, abaxial aperture usually less than 1 mm (ca. 2.2 mm in *M. involucriformis*).
- 15a. Terminal inflorescences closely subtended by 2 bractlike leaves 1.5–3.5 cm; bracts 4–7 mm; nutlets ca. 2.6 mm, abaxial aperture ca. 2.2 mm ..... 10. *M. involucriformis*
- 15b. Terminal inflorescences subtended by 1 leaf, if 2 then not adjacent, or smaller than 1 cm; bracts extremely small, nutlets less than 2 mm, abaxial aperture less than 1 mm.
- 16a. Corolla limb 3.8–5.5(–9) mm wide.
- 17a. Leaf blade mostly elliptic, to 2.7 cm; corolla limb ca. 5.5 mm wide ..... 2. *M. muliensis*
- 17b. Leaf blade lanceolate to oblong, to 5.5 cm; corolla limb 3.8–9 mm wide ..... 13. *M. pseudotrichocarpa*
- 16b. Corolla limb 2–3 mm wide.
- 18a. Upper stem leaves elliptic to oblong, 0.5–1.5 cm; corolla blue ..... 3. *M. pustulosa*
- 18b. Upper stem leaves oblong to lanceolate, 1–6 cm; corolla white or with light yellow throat.
- 19a. Stem leaves oblong, 1–2.2 cm; stems to 11 cm tall; corolla white ..... 15. *M. polygonoides*
- 19b. Stem leaves narrowly lanceolate to narrowly oblong, 1.5–6 cm; stems ca. 5 cm tall; corolla light blue with light yellow throat ..... 18. *M. hispidissima*
- 11b. Stems hispid or glabrous or nearly so.
- 20a. Basal part of stem glabrous or nearly so.
- 21a. Petiole of lower stem leaves long; leaf blade ovate, cuneate-orbicular to cordate-cuneate at base; pedicels of lowermost flowers 2–4 cm ..... 6. *M. longipes*
- 21b. Petiole of lower stem leaves less than 3 cm; leaf blade broadly cuneate to attenuate at base; pedicels of lowermost flowers less than 2(–3.2) cm.
- 22a. Plants sparsely pubescent; leaves glabrous abaxially; pedicel 0.8–1 mm; calyx glabrous outside; nutlets ca. 3 mm, abaxial aperture ca. 2.8 mm ..... 19. *M. rockii*
- 22b. Plants hispid; leaves pubescent on abaxial surface; pedicel 8–32 mm; calyx pubescent outside; nutlets less than 2.7 mm, abaxial aperture 0.6–2.5 mm.
- 23a. Stem leaves elliptic to narrowly ovate, short strigose; pedicel 1–3.2 cm; calyx densely short strigose; corolla limb 3–4 mm wide; abaxial aperture of nutlets 1.5–2.5 mm ..... 5. *M. bhutanica*
- 23b. Stem leaves narrowly oblong to narrowly elliptic, glabrous or sparsely short strigose abaxially; pedicel to 0.2 cm; calyx pubescent along midvein; corolla limb 5–7 mm wide; abaxial aperture of nutlets ca. 0.6 mm ..... 14. *M. oblongifolia*
- 20b. Basal part of stem ± hispid.
- 24a. Stem leaves elliptic to narrowly ovate.
- 25a. Aperture of nutlets at apex of abaxial surface ..... 1. *M. ovalifolia*
- 25b. Aperture of nutlets at middle of abaxial surface.

- 26a. Stems spreading hispid or bristly, 11–19 cm; nutlets 1.6–1.8 mm, abaxial aperture 0.7–0.9 mm, attachment scar near base ..... 2. *M. muliensis*
- 26b. Stems densely short hispid, to 8 cm; nutlets ca. 1.5 mm, abaxial aperture ca. 0.5 mm, attachment scar at middle on adaxial surface ..... 4. *M. myosotideae*
- 24b. Stem leaves spatulate or oblanceolate.
- 27a. Flowers in spikelike branches, with distinct bracts; bracts leaflike, oblong, 3–9 mm ..... 17. *M. younghusbandii*
- 27b. Flowers few, forming short crowded inflorescences, with obscure bracts.
- 28a. Stems to 5 cm.
- 29a. Leaf blade spatulate, 1.4–4.5 cm × 3.5–8 mm; corolla limb 3–3.5 mm wide ..... 16. *M. spatulata*
- 29b. Leaf blade narrowly oblong to narrowly oblong-oblanceolate, 0.7–1.9 cm × 2–4 mm; corolla limb 2–2.5 mm wide ..... 17. *M. younghusbandii*
- 28b. Stems more than 12 cm.
- 30a. Stems with solitary leaf-opposed flowers at branching points above middle ..... 12. *M. ciliaris*
- 30b. Stems without solitary leaf-opposed flowers.
- 31a. Corolla limb ca. 2 mm wide, appendages lunate, ca. 0.2 mm; nutlets ca. 2.4 mm, abaxial aperture ca. 1 mm, attachment scar near base ..... 11. *M. jilongensis*
- 31b. Corolla limb 5–7 mm wide, appendages nearly trapeziform, ca. 0.5 mm; nutlets ca. 1.8 mm, abaxial aperture ca. 0.4 mm, attachment scar at middle or below on adaxial surface ..... 14. *M. oblongifolia*

**1. *Microula ovalifolia*** (Bureau & Franchet) I. M. Johnston, Contr. Gray Herb. 73: 62. 1924.

卵叶微孔草 luan ye wei kong cao

Stems erect or nearly so, frequently branched from base, 2.5–32 cm tall, short hispid. Basal and lower stem leaves petiolate, narrowly elliptic to spatulate; upper stem leaves sessile or petioles short, to 1.4 cm; leaf blade narrowly elliptic to ovate, 0.9–4.5 cm × 4–14 mm, short strigose, base attenuate, broadly cuneate to rounded, apex subacute, obtuse, to rounded. Terminal inflorescences frequently ± elongated and spikelike, 1.4–3 cm, few to many flowered; axillary inflorescences few flowered. Pedicel 1–5 mm. Calyx 2–2.5 mm; lobes narrowly triangular, densely pubescent outside. Corolla blue; tube ca. 2 mm, glabrous; appendages trapeziform or low trapeziform, ca. 0.5 mm, short pubescent; limb 3–7 mm wide, glabrous; lobes suborbicular to obovate. Nutlets ovoid, ca. 1.8 × 1 mm, finely tuberculate, short pubescent; aperture apical, elliptic to suborbicular, ca. 0.5 mm; attachment scar near base.

• Alpine meadows, thickets, valleys; 3300–4400 m. Sichuan, Xizang.

1a. Stems 9–32 cm; corolla limb 5–7 mm wide, glabrous outside ..... 1a. var. *ovalifolia*

1b. Stems ca. 2.5 cm; corolla limb ca. 3 mm wide, sparsely pubescent outside ..... 1b. var. *pubiflora*

**1a. *Microula ovalifolia* var. *ovalifolia***

卵叶微孔草 (原变种) luan ye wei kong cao (yuan bian zhong)

*Schistocaryum ovalifolium* Bureau & Franchet, J. Bot.

(Morot) 5: 105. 1891.

Stems 9–32 cm tall. Corolla limb 5–7 mm wide, glabrous outside. Fl. Jul-Sep.

• Alpine meadows, thickets; 3300–4400 m. W Sichuan.

**1b. *Microula ovalifolia* var. *pubiflora*** W. T. Wang, Acta Phytotax. Sin. 18: 112. 1980.

毛花卵叶微孔草 mao hua luan ye wei kong cao

Stems ca. 2.5 cm tall. Corolla limb ca. 3 mm wide, sparsely pubescent outside.

• Valleys; ca. 4200 m. Xizang (Yadong Xian).

**2. *Microula muliensis*** W. T. Wang, Acta Phytotax. Sin. 18: 270. 1980.

木里微孔草 mu li wei kong cao

Stems branched from base, 11–19 cm tall, sparsely spreading hispid or bristly. Petiole of basal and lower leaves to 1 cm; leaf blade elliptic-ovate to spatulate-elliptic, 1.4–2.7 cm × 4–10 mm, base attenuate to broadly cuneate, apex obtuse to rounded; upper stem leaves sessile, elliptic, smaller, 4–14 mm, densely short strigose, abaxially with more hairs. Inflorescences terminal and axillary, short, crowded, several flowered; bracts narrowly elliptic, to 2 mm. Pedicel ca. 1 mm. Calyx ca. 2 mm, to 4 mm in fruit, parted nearly to base; lobes linear, short strigose, margin densely short hispid, apex obtuse. Corolla dark blue; tube ca. 1.8 mm, glabrous; appendages deltate, ca. 0.7 mm, margin short pubescent; limb

ca. 5.5 mm wide, glabrous; lobes suborbicular. Nutlets ovoid, 1.6–1.8 × 1–1.2 mm, finely tuberculate, short pubescent; aperture above middle, narrowly elliptic, 0.7–0.9 mm; attachment scar near base. Fl. Aug.

• Alpine meadows; ca. 3500 m. Sichuan (Muli Xian).

**3. *Microula pustulosa*** (C. B. Clarke) Duthie, Bull. Misc. Inform. Kew 1912: 39. 1912.

小果微孔草 xiao guo wei kong cao

Stems ascending, usually branched from base, 4–8 cm tall, densely short hispid, with few intermixed bristles. Petiole of basal and lower stem leaves to 6 mm; leaf blade spatulate to oblong; upper stem leaves short petiolate to sessile, elliptic to oblong, 0.5–1.5 cm × 2–5 mm, densely short strigose, base attenuate to broadly cuneate, apex subacute to obtuse. Pedicel to 3 mm, densely short strigose. Flowers opposite leaves, or few and crowded in terminal short inflorescences. Calyx ca. 1.8 mm, parted nearly to base; lobes narrowly triangular, densely short pubescent outside. Corolla blue; tube 1–1.2 mm; appendages lunate, ca. 0.2 mm, with hairs; limb 2.5–3 mm wide; lobes broadly elliptic-obovate. Nutlets ovoid, 1.5–1.8 × ca. 1.2 mm, finely tuberculate, glabrous or short pubescent; aperture above middle, suborbicular, 0.2–0.3 mm wide; attachment scar at lower part of adaxial surface. Fl. Aug-Sep.

Alpine meadows, gravelly slopes; 4100–4700 m. Qinghai, Xizang [Bhutan, India].

- 1a. Leaves densely short strigose;  
nutlets short pubescent ..... 3a. var. *pustulosa*  
1b. Leaves densely strigose, bristly;  
nutlets glabrous ..... 3b. var. *setulosa*

**3a. *Microula pustulosa* var. *pustulosa***

小果微孔草 (原变种) xiao guo wei kong cao (yuan bian zhong)

*Eritrichium pustulosum* C. B. Clarke in J. D. Hooker, Fl. Brit. India 4: 164. 1885.

Leaves densely short strigose. Nutlets finely tuberculate, short pubescent.

Alpine meadows, gravelly slopes; 4100–4700 m. S Qinghai, S and SE Xizang [Bhutan, NE India].

**3b. *Microula pustulosa* var. *setulosa*** W. T. Wang, Acta Phytotax. Sin. 18: 112. 1980.

刚毛小果微孔草 gang mao xiao guo wei kong cao

Stem leaves densely strigose and bristly. Nutlets glabrous.

• Gravelly slopes; 4200–4300 m. NE Xizang (Naqu Xian).

**4. *Microula myosotidea*** (Franchet) I. M. Johnston, Contr. Gray Herb. 73: 62. 1924.

鹤庆微孔草 he qing wei kong cao

*Schistocaryum myosotideum* Franchet, Bull. Mens. Soc. Linn., Paris 2: 903. 1891; *Anoplocaryum myosotideum* (Franchet) Brand.

Stems erect, branched from base or not branched, 1.4–8 cm tall, densely short hispid. Basal and lower stem leaves short petiolate, spatulate; upper stem leaves sessile or nearly so, narrowly elliptic, 0.6–1.6 cm × 2–2.5 mm, densely short strigose, base attenuate to broadly cuneate, apex obtuse to rounded. Flowers opposite leaves on lower part of stems and upward, or several flowers at apices of stems and branches forming short inflorescences. Calyx ca. 2 mm, parted nearly to base; lobes linear-lanceolate, sparsely long hispid outside and along margin, short strigose inside at apex. Corolla blue, glabrous; tube ca. 1.8 mm; appendages trapeziform, ca. 0.4 mm; limb ca. 4 mm wide; lobes orbicular-obovate. Nutlets broadly ovoid, ca. 1.5 × 1.2 mm, finely tuberculate, glabrous; aperture above middle, elliptic, ca. 0.5 mm; attachment scar at middle of adaxial surface. Fl. Aug.

• Alpine meadows; ca. 3800 m. Yunnan (Heqing Xian).

**5. *Microula bhutanica*** (T. Yamazaki) H. Hara, J. Jap. Bot. 51: 9. 1976.

大孔微孔草 da kong wei kong cao

*Actinocarya bhutanica* T. Yamazaki, J. Jap. Bot. 46: 52. 1971.

Stems erect or ascending, frequently branched from base, or not branched, 5–22 cm tall, sparsely short hispid or glabrescent below. Petiole of basal and lower leaves 0.6–3 cm; leaf blade spatulate to elliptic, 2.5–6.5 × 0.7–2 cm, base attenuate or broadly cuneate, apex subacute to subobtuse; upper stem leaves short petiolate to sessile, narrowly elliptic to narrowly ovate or ovate, 0.6–3 cm, short strigose. Pedicel of lower flowers 1–2.2(–3.2) cm, sparsely hispid above. Flowers opposite leaves on lower or middle part of stems and above; lower flowers thin, long pedicellate; upper flowers forming terminal short crowded inflorescences. Calyx 1.5–2 mm, to 3 mm in fruit, parted nearly to base; lobes narrowly triangular, densely short strigose outside, sparsely pubescent inside. Corolla blue, glabrous; tube 1.2–1.8 mm; appendages lunate, ca. 0.2 mm; limb 3–4 mm wide, glabrous; lobes suborbicular. Nutlets ovoid, 2.2–2.7 × 2–2.2 mm, finely tuberculate or wrinkled, sparsely short pubescent; aperture elliptic to suborbicular, 1.5–2.5 mm, on upper 2/3 to entire abaxially; attachment scar at middle of adaxial surface. Fl. Jul-Sep.

Barren slopes, rock crevices, forest margins; 3000–4100 m. SW Sichuan (Muli Xian), N Yunnan [Bhutan].

**6. *Microula longipes*** W. T. Wang, Acta Phytotax. Sin. 18: 272. 1980.

长梗微孔草 chang geng wei kong cao

Stems erect, not branched or with a single branch above, 9–18 cm tall, glabrous below, sparsely short hispid above. Basal leaf 1; lower stem leaves long petiolate; upper stem leaves subsessile; petiole 0.8–6 cm, sparsely short hispid; leaf

blade elliptic-ovate to ovate, 1.5–10 × 1–2.8 cm, sparsely short strigose, base broadly cuneate to cordate-cuneate, apex mucronate. Flowers opposite leaves on middle or upper part of stems. Pedicel of lower flowers thin, 2–4 cm; pedicel of upper flowers 2–10 mm, sparsely short pubescent. Calyx ca. 1.8 mm, parted nearly to base; lobes narrowly triangular, glabrous outside, sparsely pubescent inside, apex subacute, markedly 3-veined. Corolla blue, glabrous; tube ca. 1.2 mm; appendages lunate, ca. 0.2 mm; limb ca. 4.5 mm wide, glabrous; lobes suborbicular. Anthers narrowly oblong, ca. 0.5 mm. Nutlets unknown. Fl. Jul.

- Slopes, forest margins; 3300–3500 m. Sichuan (Muli Xian).

**7. *Microula forrestii*** (Diels) I. M. Johnston, Contr. Gray Herb. 81: 83. 1928.

丽江微孔草 li jiang wei kong cao

*Omphalodes forrestii* Diels, Notes Roy. Bot. Gard. Edinburgh 5: 169. 1912; *Microula hirsuta* I. M. Johnston.

Stems erect, short branched, 20–30(–60) cm tall, densely spreading hispid. Lower stem leaves long petiolate; middle stem leaves short petiolate; upper stem leaves sessile, narrowly elliptic, 3–10 × 1–2.8 cm, hispid, base attenuate, margin entire, apex obtuse to rounded. Inflorescences terminating branches, ca. 1 cm wide, ca. 7-flowered, with 2 subtending leaves. Flowers pedicellate, crowded. Calyx 4–5.5 mm, parted nearly to base; lobes narrowly triangular, densely hirsute outside, long hispid inside. Corolla blue; tube ca. 2.5 mm, glabrous; appendages low trapeziform, ca. 1 mm, apex short pubescent; limb 6–7 mm wide; lobes orbicular-ovate, sparsely short strigose outside. Nutlets triangular-ovoid, ca. 3 × 2.3 mm, with irregular conical emergences; aperture narrowly oblong, ca. 2.2 mm; attachment scar above base adaxially. Fl. Jul.

- Alpine slopes. Yunnan.

**8. *Microula sikkimensis*** (C. B. Clarke) Hemsley, Hooker's Icon. Pl. 26: t. 2562. 1898.

微孔草 wei kong cao

*Anchusa sikkimensis* C. B. Clarke in J. D. Hooker, Fl. Brit. India 4: 168. 1883; *Anoplocaryum limprichtii* Brand; *Tretocarya sikkimensis* (C. B. Clarke) Oliver.

Stems erect or ascending, not crowded, frequently branched from base, or not branched, 6–65 cm tall, bristly, sometimes sparsely strigose. Basal and lower stem leaves long petiolate, broadly lanceolate to ovate or narrowly ovate, 4–12 × 0.7–4.4 cm, base rounded to broadly cuneate, apex acute to acuminate, rarely obtuse; upper stem leaves gradually reduced upward, short petiolate to sessile, narrowly ovate to broadly lanceolate, short strigose, abaxially bristly along midvein, adaxially sparsely bristly, hairs discoid at base, base attenuate, margin entire. Inflorescences terminal, crowded, 0.5–1.5 cm wide, sometimes slightly elongated to ca. 2 cm; basal bracts leaflike, other bracts 0.5–2 mm. Pedicel densely short strigose. Calyx ca. 2 mm, to 3.5 mm in fruit, parted nearly to base; lobes linear to narrowly triangular, sparsely pubescent and long hispid outside, margin densely pubescent and short strigose inside. Corolla blue or blue-purple; tube

2.5–3.8 mm, glabrous; appendages low trapeziform or lunate, ca. 0.3 mm, glabrous or short pubescent; limb 5–9(–11) mm wide, glabrous; lobes suborbicular. Nutlets ovoid, ± dorsiventrally compressed, 2–2.5 × ca. 1.8 mm, with fine tubercles and short hairs; aperture in middle and upper parts of abaxial surface, narrowly oblong, 1–1.5 mm; attachment scar at center of adaxial surface. Fl. May–Sep.

Hillside meadows, thickets, forest margins, river banks, fields; 2900–4500 m. Gansu, Qinghai, SW Shaanxi, W Sichuan, SE Xizang, NW Yunnan [Bhutan, India, Nepal, Sikkim].

**9. *Microula blepharolepis*** (Maximowicz) I. M. Johnston, J. Arnold Arbor. 33: 72. 1952.

尖叶微孔草 jiang ye wei kong cao

*Omphalodes blepharolepis* Maximowicz, Bull. Acad. Imp. Sci. Saint Pétersbourg 37: 504. 1881.

Stems unbranched or short branched, 9–12 cm tall, spreading bristly. Leaf blade of lower stems ovate to narrowly ovate, 3–7 × 0.9–1.4 cm, base rounded, abruptly constricted into a petiole 3–3.2 cm, apex acute. Upper leaves gradually reduced upward; petiole short, bristly; leaf blade lanceolate, 1.5–4 mm, densely short strigose, base broadly cuneate to attenuate, apex acuminate. Inflorescences terminal or sometimes from upper axils, crowded, short; bracts lanceolate, 2–4 mm. Pedicel 0.5–2 mm. Calyx ca. 2 mm, parted nearly to base; lobes triangular-lanceolate, densely hirsute outside, and sparsely short strigose inside. Corolla tube ca. 1.8 mm, glabrous; appendages low trapeziform, ca. 0.5 mm, apex pubescent; limb ca. 2.5 mm wide, glabrous; lobes suborbicular. Anthers narrowly oblong, ca. 0.6 mm. Nutlets tuberculate.

- Qinghai (Xinghai Xian).

**10. *Microula involucriformis*** W. T. Wang, Acta Phytotax. Sin. 18: 273. 1980.

总苞微孔草 zong bao wei kong cao

Stems branched from lower part, ca. 48 cm tall, ca. 4 mm in diam., bristly; branches to 10 cm. Lower and middle stem leaves petiolate; leaf blade spatulate-oblong to narrowly oblong, ca. 6.5 × 1.5–1.9 cm, base attenuate to cuneate, apex subacute; upper leaves sessile, long elliptic to narrowly ovate, 4–5.8 cm, densely strigose, sparsely bristly. Inflorescences terminal, 5–14 mm wide; subtending leaves usually 2, sessile, orbicular-ovate to broadly ovate, 1.5–3.5 cm; bracts orbicular-ovate to ovate, 4–7 × 3–6 mm. Flowers short pedicellate, crowded. Calyx ca. 2.8 mm, parted to base; lobes linear-lanceolate, short strigose, margin densely long hispid, with intermixed bristles. Corolla blue; tube ca. 2.2 mm, glabrous; appendages trapeziform, ca. 0.3 mm, apex minutely hispid; limb ca. 4.5 mm wide; lobes orbicular-ovate, glabrous. Nutlets ovoid, ± dorsiventrally compressed, ca. 2.6 × 2 mm, sparsely tuberculate; aperture narrowly oblong, ca. 2.2 mm; attachment scar at center of adaxial surface. Fl. Jun–Jul.

- Mountains; ca. 3100 m. Sichuan (Baoping Xian).

**11. *Microula jilongensis*** W. T. Wang, Acta Phytotax. Sin. 18: 112. 1980.

吉隆微孔草 *ji long wei kong cao*

Stems several, branched from base, ca. 12 cm tall, appressed or spreading, moderately densely minute hispid, not bristly. Petiole of basal and lower stem leaves to 1.5 cm; leaf blade narrowly oblanceolate to narrowly oblong, 3–4 cm × 5–7 mm, base attenuate, apex subobtuse to subacute; upper leaves sessile, oblong to narrowly oblong, 1.5–3.5 cm, moderately densely short strigose. Inflorescences terminal; bracts triangular to narrowly elliptic, 1–6 mm. Pedicel and inflorescence branches gray short strigose. Flowers crowded. Calyx ca. 2 mm, parted nearly to base; lobes narrowly triangular, densely hispid outside, apex sparsely strigose inside. Corolla blue; tube ca. 1.2 mm, glabrous; appendages lunate, ca. 0.2 mm, apex short pubescent; limb ca. 2 mm wide, glabrous; lobes suborbicular. Anthers narrowly elliptic, ca. 0.7 mm. Nutlets ovoid, ca. 2.4 × 1.5 mm, with few tubercles, glabrous; aperture in upper part of abaxial surface, narrowly oblong, ca. 1 mm; attachment scar near base. Fl. Jul-Aug.

- Meadows; ca. 4000 m. Xizang (Gyirong Xian).

**12. *Microula ciliaris*** (Bureau & Franchet) I. M. Johnston, *Contr. Gray Herb.* 73: 62. 1924.

巴塘微孔草 *ba tang wei kong cao*

*Schistocaryum ciliare* Bureau & Franchet, *J. Bot. (Morot)* 5: 105. 1891; *Omphalodes ciliaris* (Bureau & Franchet) Brand.

Stems erect, to 14 cm tall, sparsely short strigose and spreading hispid; branches with 2 leaves subtending inflorescences. Basal and lower stem leaves long petiolate, spatulate, 2.8–4.7 cm × 4–9 mm, base attenuate, apex obtuse; upper stem leaves ± sessile, narrowly oblong to spatulate-ob lanceolate, 1.8–3.4 cm, short strigose, apex acute. Inflorescences terminal, crowded, 5–10 mm wide; bracts narrowly triangular to linear-lanceolate, 2–5 mm; upper branches with flowers at branching points, opposite leaves. Pedicel 0.5–2.5 mm. Flowers long pedicellate. Calyx ca. 3 mm, parted to base; lobes triangular-lanceolate, sparsely short strigose, margin densely pubescent. Corolla blue, glabrous; tube ca. 2 mm; appendages low trapeziform, ca. 0.5 mm; limb ca. 8 mm wide; lobes suborbicular. Fl. Jun.

- Alpine meadows; ca. 3800 m. SW Sichuan.

**13. *Microula pseudotrichocarpa*** W. T. Wang, *Acta Phytotax. Sin.* 18: 274. 1980.

甘青微孔草 *gan qing wei kong cao*

Stems erect to ascending, branched from base or above middle, 10–44 cm tall, sparsely strigose and spreading bristly. Basal and lower stem leaves long petiolate, lanceolate-oblong to narrowly spatulate-ob lanceolate or oblong, (1–)3–5.5 × 5–15 cm, base attenuate, apex ± acute; upper stem leaves ± sessile, narrowly elliptic to narrowly oblong, smaller, 1–3 cm, strigose, sparsely bristly. Inflorescences terminal or axillary, initially crowded, subglobose, to 1.5 cm in fruit, sometimes with a long pedicellate flower opposite a leaf at branching on middle of stem; bracts lanceolate to narrowly elliptic, 1–4 cm. Pedicel to 1 mm, to 5 mm in ebracteate flower below

inflorescences. Calyx 2–2.5 mm, short strigose and sparsely hirsute, parted nearly to base; lobes linear-triangular. Corolla blue, glabrous; tube 1.5–2(–3) mm; appendages low trapeziform or lunate, ca. 0.3 mm; limb 3.8–9 mm wide; lobes broadly ovate. Nutlets ovoid, ca. 2 × 1.2 mm, with fine tubercles and short hairs; aperture oblong, ca. 1 mm; attachment scar near middle adaxially. Fl. Jun-Aug.

- Alpine meadows; 2200–4600 m. Gansu, E Qinghai, Sichuan, Xizang.

- 1a. Corolla limb 3.8–5.5 mm wide ..... 13a. var. *pseudotrichocarpa*  
1b. Corolla limb 7–9 mm wide ..... 13b. var. *grandiflora*

**13a. *Microula pseudotrichocarpa* var. *pseudotrichocarpa***

甘青微孔草 (原变种) *gan qing wei kong cao* (yuan bian zhong)

Corolla limb 3.8–5.5 mm wide.

- Alpine meadows; 2200–4500 m. Gansu, E Qinghai, NW Sichuan, E Xizang.

**13b. *Microula pseudotrichocarpa* var. *grandiflora*** W. T. Wang, *Acta Phytotax. Sin.* 18: 274. 1980.

大花甘青微孔草 *da hua gan qing wei kong cao*

Corolla limb 7–9 mm wide.

- Alpine meadows; 3000–4600 m. Sichuan (Muli Xian), Xizang (Lhasa Shi).

**14. *Microula oblongifolia*** Handel-Mazzetti, *Symb. Sin.* 7: 821. 1936.

长圆微孔草 *chang yuan wei kong cao*

Stems frequently several from base, 16–20 cm tall, densely nearly spreading hispid and sparsely bristly, or glabrous on lower parts. Lower stem leaves petiolate; upper stem leaves sessile, spatulate-ob lanceolate to narrowly oblong or narrowly elliptic, 1–7 × 4–11 cm, sparsely short hispid or abaxially glabrous or sparsely short strigose along midvein, base attenuate to broadly cuneate, apex ± acute to obtuse. Inflorescences terminal, 5–7 mm wide, few flowered. Pedicel to 2 mm. Flowers crowded. Calyx ca. 2 mm, parted nearly to base; lobes lanceolate, hirsute or pubescent only along midvein outside. Corolla blue, glabrous; tube ca. 1.8 mm; appendages nearly trapeziform, ca. 0.5 mm; limb 5–7 mm wide; lobes orbicular-obovate. Nutlets triangular-ovoid, ca. 1.8 × 1.5 mm, with fine conical tubercles and short hairs; aperture suborbicular, ca. 0.4 mm in diam.; attachment scar at middle or below on adaxial surface. Fl. Jun-Jul.

- Alpine meadows, forests, forest margins; 3200–3700 m. Yunnan.

- 1a. Stems ± spreading hispid, sparsely bristly; leaf blade sparsely short hispid; calyx hirsute; nutlet attachment scar

at middle of adaxial surface ..... 14a. var. *oblongifolia*  
1b. Stems glabrous on lower parts, sparsely strigose at apex; abaxial surface of leaf blade glabrous or sparsely short strigose along midvein only; calyx glabrous except for pubescent midvein outside; nutlet attachment scar below middle of adaxial surface ..... 14b. var. *glabrescens*

**14a. *Microula oblongifolia* var. *oblongifolia***

长圆微孔草 (原变种) chang yuan wei kong cao (yuan bian zhong)

Stems ± spreading hispid, sparsely bristly. Leaf blade sparsely short hispid. Calyx hirsute. Nutlet attachment scar at middle of adaxial surface.

• Alpine meadows; 3200–3400 m. Yunnan (Yulong Shan of Lijiang Xian).

**14b. *Microula oblongifolia* var. *glabrescens* W. T. Wang, Acta Phytotax. Sin. 18: 275. 1980.**

疏毛长圆微孔草 shu mao chang yuan wei kong cao

Stems glabrous on lower parts, sparsely strigose at apex. Abaxial surface of leaf blade glabrous or sparsely short strigose along midvein only. Calyx glabrous except for pubescent midvein outside. Nutlet attachment scar below middle of adaxial surface.

• Forests, forest margins; 3400–3700 m. Yunnan (Zhongdian Xian).

**15. *Microula polygonoides* W. T. Wang, Acta Phytotax. Sin. 18: 275. 1980.**

蓼状微孔草 liao zhuang wei kong cao

Stems branched from base, 6–11 cm tall, densely short strigose, somewhat spreading bristly; branches 3–6, gradually ascending or suberect, with short secondary branchlets to 2 cm. Lower stem leaves petiolate; upper stem leaves ± sessile, gradually reduced upward, narrowly oblong to oblong, 1–2.2 cm × 3–6 mm, abaxially densely short strigose, adaxially densely hirsute, sometimes hispid, sparsely bristly along margin, hairs discoid at base, base cuneate, apex acute. Flowers opposite leaves on lower part of stems, few borne in leaf axils and apices of branches. Pedicel less than 1 mm, to 1–2 mm in fruit, hispid. Calyx ca. 2 mm, to 3 mm in fruit; lobes narrowly triangular, hirsute outside. Corolla white, glabrous; tube ca. 1 mm; appendages lunate, ca. 0.2 mm; limb ca. 2 mm wide; lobes suborbicular. Nutlets ovoid, ca. 1.5 × 1 mm, finely tuberculate, glabrous; aperture at center. Fl. Aug–Sep.

• Hillsides; ca. 3300 m. Yunnan (Dêqên Xian).

**16. *Microula spathulata* W. T. Wang, Acta Phytotax. Sin. 18: 276. 1980.**

匙叶微孔草 chi ye wei kong cao

Stems gradually ascending, branched from base, 2.2–5

cm tall, densely obliquely spreading and appressed hispid. Basal and lower stem leaves long petiolate; petiole of upper stem leaves 0.2–1.8 cm; leaf blade spatulate, 1.4–4.5 cm × 3.5–8 mm, abaxially glabrous except for midvein and margin short strigose, adaxially more strigose, base attenuate, apex rounded to acute. Flowers opposite leaves. Pedicel of lower flowers 14–22 mm, 1–3 mm in upper flowers. Calyx ca. 2.8 mm, parted nearly to base; lobes narrowly triangular-lanceolate, densely pubescent outside, apex subobtuse. Corolla blue; tube ca. 2 mm, glabrous; appendages lunate, ca. 0.2 mm, sparsely short pubescent; limb 3–3.5 mm wide, glabrous; lobes suborbicular. Nutlets ovoid, ca. 1.8 mm, slightly wrinkled; aperture oblong to narrowly oblong, 1–1.5 mm; attachment scar below middle adaxially. Fl. Jun.

• Alpine meadows; ca. 3300 m. Yunnan (Zhongdian Xian).

**17. *Microula younghusbandii* Duthie, Bull. Misc. Inform. Kew 1912: 40. 1912.**

小微孔草 xiao wei kong cao

*Eritrichium younghusbandii* (Duthie) Brand; *Microula bohrispermoides* W. T. Wang.

Stems erect to gradually ascending, frequently branched from base, 1.5–5 cm tall, densely hispid. Basal and lower stem leaves ± sessile, narrowly oblong to oblong-oblancoleolate, 0.7–1.9 cm × 2–4 mm, short strigose, base attenuate, apex acute. Inflorescences bracteate on stems and branches; bracts narrowly oblong, 3–9 mm, densely strigose. Pedicel 1–4 mm. Flowers opposite leaves, or forming short and crowded or narrow and long spikelike branches. Calyx 1.5–1.7 mm, parted nearly to base; lobes triangular-lanceolate, densely hispid outside. Corolla blue-purple or white, glabrous; tube 1.2–1.3 mm; appendages low trapeziform, 0.2–0.4 mm; limb 2–2.5 mm wide; lobes suborbicular. Nutlets triangular-ovoid to broadly ovoid, 1.2–2 × 1–1.5 mm, finely tuberculate, glabrous; aperture elliptic to oblong, 0.5–0.8 mm, at middle; attachment scar at or below middle of adaxial surface. Fl. Jun–Sep.

• Alpine meadows, ravines, thickets; 3000–4200 m. Qinghai (Nangqên Xian), W Sichuan, S Xizang, NW Yunnan (Zhongdian Xian).

**18. *Microula hispidissima* W. T. Wang, Acta Phytotax. Sin. 18: 113. 1980.**

密毛微孔草 mi mao wei kong cao

Roots straight, to 20 cm, crowns 2–6 mm in diam. Stems branched from base, ca. 5 cm tall, densely spreading bristly. Leaves mostly petiolate, only uppermost sessile; petiole 0.5–2 cm; leaf blade spatulate, narrowly lanceolate to narrowly oblong, 1.5–6 cm × 4–10 mm, densely and minutely hispid, abaxially with long bristles along midvein and margin, adaxially sparsely hispid, hairs discoid at base, base attenuate, apex obtuse to subacute. Inflorescences terminal on branches; bracts narrowly elliptic, to 5 mm, densely hispid, bristly; flowers also at branching points on lower part of stems. Flowers few, crowded, short pedicellate. Calyx ca. 2.5 mm, parted nearly to base; lobes narrowly triangular, hirsute outside, margin densely short hispid. Corolla light blue; throat light yellow; tube ca. 1.4 mm, glabrous; appendages low

trapeziform, ca. 0.3 mm, densely minutely hispid; limb ca. 3 mm wide; lobes orbicular-ovate, glabrous. Nutlets ovoid, ca. 1.8 mm, somewhat tuberculate; aperture above middle, elliptic, ca. 0.6 mm; attachment scar at middle of adaxial surface. Fl. Jun.

- Alpine meadows; ca. 3600 m. Xizang (Nyalam Xian).

**19. *Microula rockii*** I. M. Johnston, Contr. Gray Herb. 81: 82. 1928.

柔毛微孔草 ruo mao wei kong cao

*Anoplocaryum rockii* (I. M. Johnston) Brand.

Stems frequently branched from below, 6–20 cm tall, sparsely pubescent, usually glabrous below. Lower stem leaves petiolate; leaf blade spatulate to oblanceolate, 1.4–2.9 cm × 4–8 mm, base attenuate, apex rounded to obtuse; upper stem leaves sessile, elliptic to ovate, gradually reduced, 4–12 mm, abaxially glabrous, adaxially sparsely pubescent or glabrescent. Inflorescences several, crowded, or 1-flowered at apices of short branches. Pedicel 0.8–1 mm. Calyx blue, ca. 2 mm, parted nearly to base, glabrous outside, ciliate along margin, appressed pubescent inside. Corolla light blue, glabrous; tube (1.2–)1.8–2 mm; appendages nearly trapeziform, ca. 0.5 mm; limb 3.5–8 mm wide; lobes suborbicular. Nutlets ovoid, ca. 3 × 2 mm, sparsely short pubescent, finely tuberculate below; aperture narrowly oblong, ca. 2.8 mm; attachment scar at middle of adaxial surface. Fl. Jul.

- Alpine meadows; 3400–4000 m. SW Gansu (Xiahe Xian), Qinghai.

**20. *Microula leiocarpa*** W. T. Wang, Acta Phytotax. Sin. 18: 277. 1980.

光果微孔草 guang guo wei kong cao

Stems suberect, branched from base, 2–3 cm tall, spreading bristly. Petiole 2–10 mm; leaf blade narrowly lanceolate to spatulate or narrowly oblong, 1–3.5 cm × 3–9 mm, strigose, base attenuate, apex acute to subobtusely. Inflorescences terminal, few flowered; bracts narrowly elliptic, 3–7 mm. Calyx ca. 1.5 mm, to 3 mm in fruit, parted nearly to base; lobes narrowly triangular, short strigose outside, densely hispid along margin. Corolla blue, glabrous; tube ca. 1.5 mm; appendages lunate, ca. 0.2 mm; limb ca. 1.6 mm wide; lobes orbicular-ovate. Nutlets ovoid, 1.5–1.8 × 1–1.2 mm, glabrous, slightly shiny, brown-black spotted; aperture narrowly oblong, 1–1.1 mm; attachment scar below middle of adaxial surface. Seeds ovate, ca. 1.2 × 1 mm. Fl. Aug-Sep.

- Moist shaded places in valleys; ca. 2700 m. Yunnan (Dêqên Xian).

**21. *Microula efoveolata*** W. T. Wang, Acta Phytotax. Sin. 18: 277. 1980.

无孔微孔草 wu kong wei kong cao

Stems branched from base, 6–19 cm tall, densely spreading hispid. Basal and lower stem leaves petiolate, spatulate to narrowly obovate, 4–6 cm × 5–9 mm, base

attenuate, apex subacute to rotund; upper stem leaves gradually reduced upward, sessile, narrowly oblong to narrowly elliptic, 1.6–3.7 cm, sparsely short strigose. Inflorescences terminal, few flowered; 2 lowermost bracts elliptic, 6–10 mm, other bracts triangular to narrowly elliptic, 1.5–3 mm; branching points of upper stem with a solitary long pedicellate flower. Flowers crowded. Calyx ca. 2.5 mm, to 4.8 mm in fruit, parted nearly to base; lobes narrowly triangular, short hispid and sparsely hirsute outside. Corolla blue; tube ca. 2 mm, glabrous; appendages low trapeziform, ca. 0.3 mm, apex short pubescent; limb ca. 4 mm wide, glabrous; lobes suborbicular. Nutlets slightly bilaterally compressed, abaxially rhomboid-triangular, ca. 1.8 × 1 mm, center longitudinally ribbed, without aperture; lateral surfaces ca. 1.2 mm wide, with few fine tubercles and extremely short hairs; attachment scar above base of adaxial surface. Fl. Jun-Jul.

- Alpine meadows; ca. 3400 m. Sichuan (Muli Xian).

**22. *Microula trichocarpa*** (Maximowicz) I. M. Johnston, Contr. Gray Herb. 81: 83. 1928.

长叶微孔草 chang ye wei kong cao

Stems erect, branched above or throughout, 15–45 cm tall, moderately densely spreading bristly or hispid. Stem leaves gradually reduced upward, short petiolate to sessile, narrowly oblong to narrowly spatulate, 2–9 cm, short strigose, adaxially sparsely bristly, base attenuate, margin entire to obscurely finely dentate, apex acute. Inflorescences terminal, ca. 1 cm wide, sometimes slightly elongated to 1.5 cm; bracts to 2 mm. Flowers crowded, long pedicellate, opposite leaves on upper stems. Calyx 1.7–2.2 mm, to 3.5 mm in fruit, parted nearly to base; lobes narrowly triangular, sparsely long hispid and hirtellous outside, short strigose inside. Corolla blue; tube 1.5–5 mm, glabrous; appendages triangular to lunate, ca. 0.3 mm, short hispid; limb 4–10 mm wide, glabrous or sparsely pubescent outside; lobes suborbicular. Nutlets gray-white, broadly ovoid, 1.8–2.5 × 1.2–2 mm, with fine tubercles and extremely short hairs; aperture elliptic, on nearly entire adaxial surface; attachment scar at apex adaxially.

- Forests, ravines, field margins; 2400–3600 m. Gansu, E Qinghai, Shaanxi, Sichuan.

1a. Terminal inflorescences catkinlike

..... 22c. var. *lasiantha*

1b. Terminal inflorescences slightly elongated.

2a. Corolla limb 4–6.6 mm wide,

tube 1.5–2.2 mm ..... 22a. var. *trichocarpa*

2b. Corolla limb 7–10 mm wide,

tube 4–5 mm ..... 22b. var. *macrantha*

**22a. *Microula trichocarpa* var. *trichocarpa***

长叶微孔草 (原变种) chang ye wei kong cao (yuan bian zhong)

*Omphalodes trichocarpa* Maximowicz, Bull. Acad. Imp. Sci. Saint Pétersbourg 26: 500. 1880.

Terminal inflorescences slightly elongated. Corolla tube 1.5–2.2 mm; limb 4–6.6 mm wide. Fl. Jun-Jul.

• Forests, ravines, field margins; 2400–3600 m. Gansu, E Qinghai, Shaanxi (Taibai Shan), W Sichuan.

**22b. *Microula trichocarpa* var. *macrantha*** W. T. Wang, Acta Phytotax. Sin. 18: 278. 1980.

大花长叶微孔草 da hua chang ye wei kong cao

Terminal inflorescences slightly elongated. Corolla tube 4–5 mm; limb 7–10 mm wide.

• *Picea* forests. N and NW Sichuan.

**22c. *Microula trichocarpa* var. *lasiantha*** W. T. Wang, Acta Phytotax. Sin. 18: 278. 1980.

毛花长叶微孔草 mao hua chang ye wei kong cao

Terminal inflorescences catkinlike. Corolla tube 1.5–2.2 mm; limb ca. 6 mm wide, sparsely pubescent outside.

• *Abies* forests, forest margins; 3500–3600 m. NW Sichuan.

**23. *Microula turbinata*** W. T. Wang, Acta Phytotax. Sin. 18: 279. 1980.

长果微孔草 chang guo wei kong cao

Stems branched from base, to 40 cm tall, strigose, sparsely short bristly below; branches erect to gradually ascending. Lower stem leaves petiolate, oblong-elliptic to linear-oblongate, 3–7 × 0.5–1.4 cm, base attenuate, apex acute to obtuse; upper stem leaves sessile, smaller, appressed pubescent. Inflorescences terminal or axillary; bracts narrowly elliptic, 1–3 mm; lower inflorescences frequently ebracteate. Flowers crowded, those on stem long pedicellate, at branching points opposite leaves. Calyx 2–3.5 mm, to 4 mm in fruit, sparsely appressed pubescent outside, ciliate along margin, parted nearly to base; lobes lanceolate-linear. Corolla blue or white, glabrous; tube ca. 2.2 mm; appendages low trapeziform, ca. 0.4 mm; limb 5–6 mm wide; lobes orbicular-obovate. Nutlets long turbinate, 2.5–3 mm, minutely hispid, with scattered fine tubercles and 4 longitudinal ribs; aperture orbicular, at apex of nutlets. Fl. Jul–Aug.

• Alpine meadows; 3000–3900 m. SW Gansu (Xiahe Xian), SE Qinghai (Jigzhi Xian), Shaanxi (Taibai Xian), NW Sichuan.

**24. *Microula longituba*** W. T. Wang, Acta Phytotax. Sin. 18: 113. 1980.

长筒微孔草 chang tong wei kong cao

Stems with several long branches from base, ca. 24 cm tall, densely gray hispid, mixed hispid and hirsute above. Basal and lower stem leaves long petiolate; upper stem leaves short petiolate, spatulate to narrowly oblanceolate or narrowly oblong, 1.8–11 × 0.3–1.6 cm, adaxially sparsely strigose and sparsely hirsute, hairs discoid at base, base attenuate, apex rounded to subobtuse. Inflorescences terminal or axillary, 5–8 mm wide; bracts 1–2 mm. Pedicel ca. 1 mm. Flowers crowded. Calyx ca. 2 mm, parted to base; lobes lanceolate-linear, hirsute outside. Corolla dark blue, glabrous; tube 3.5–4 mm; appendages low trapeziform, 0.3–0.4 mm; limb 5–7 mm wide; lobes suborbicular, sometimes apex obtusely fine

dentate. Nutlets gray-white, rhombic-ovoid, ca. 2 × 1.2 mm, glabrous, finely tuberculate; aperture above middle, deltate, ca. 0.7 mm, inside margin with membranous emergence, surfaces obscurely longitudinally 1-ribbed; attachment scar near base. Fl. Jun–Jul.

• Alpine meadows; ca. 3600 m. E Xizang (Zogang Xian).

**25. *Microula floribunda*** W. T. Wang, Acta Phytotax. Sin. 18: 114. 1980.

多花微孔草 duo hua wei kong cao

Stems gradually ascending, branched from base, 6–32 cm tall, short strigose. Lower stem leaves petiolate; upper stem leaves sessile, spatulate to linear-spatulate or oblong, 1.5–7.5 cm × 2.5–12 mm, adaxially densely short strigose, hairs discoid at base, base attenuate, apex rounded to obtuse; midvein slightly sunken. Inflorescences terminal or axillary, many flowered, becoming ± paniculate, ca. 10 cm, much branched; branches short strigose. Pedicel 1–2.5 mm. Calyx 2–2.5 mm, to 3–3.5 mm in fruit, densely strigose outside, parted nearly to base; lobes linear-lanceolate. Corolla dark blue; tube 2–3 mm, glabrous; appendages nearly trapeziform, ca. 0.6 mm, short hispid; limb 5–8 mm wide, glabrous; lobes orbicular-obovate. Nutlets triangular-ovoid, ca. 2 × 1.5 mm, finely tuberculate; aperture deltate, on upper part of abaxial surface, ca. 1 mm; attachment scar above base adaxially. Fl. Jul–Sep.

• Hillside meadows, thickets, gravelly river banks; 3300–3800 m. S Qinghai (Nangqên Xian), NW Sichuan (Gangzi Xian), E Xizang.

**26. *Microula stenophylla*** W. T. Wang, Acta Phytotax. Sin. 18: 114. 1980.

狭叶微孔草 xia ye wei kong cao

Stems erect to ascending, frequently much branched from base, 5–24 cm tall, short strigose, spreading bristly. Leaf blade spatulate-linear to linear, 1.5–7.5 cm × 2–7 mm, abaxially sparsely bristly only along midvein, adaxially ± strigose or minutely hispid, with intermixed bristles, hairs and bristles discoid at base, base attenuate, margin sparsely short bristly, apex acute. Flowers opposite leaves from lower or middle part of stem upward, or several flowers terminating branches and forming crowded or lax short inflorescences. Calyx 1.8–2 mm, parted nearly to base; lobes narrowly triangular, hirsute outside and along margin, strigose inside. Corolla blue or white, glabrous; tube ca. 1.8 mm; appendages low trapeziform or lunate, ca. 0.3 mm; limb 1.5–2 mm wide; lobes orbicular. Nutlets triangular-ovoid, 2–2.5 × ca. 1 mm, with fine tubercles and short hairs; aperture deltate, 0.9–1.2 mm, on upper part of abaxial surface; attachment scar near base. Fl. Jun–Aug.

• Dunes, marshes, field margins, thickets; 3000–4700 m. SW Gansu (Xiahe Xian), E and S Qinghai, NW Sichuan (Zogang Xian), Xizang.

**27. *Microula diffusa*** (Maximowicz) I. M. Johnston, J. Arnold Arbor. 33: 72. 1952.

疏散微孔草 shu san wei kong cao

*Omphalodes diffusa* Maximowicz, Bull. Acad. Imp. Sci. Saint Pétersbourg 27: 504. 1881; *Tretocarya vaillantii* Danguy.

Stems ascending, much branched, (7–)15–20 cm tall, bristly. Lower stem leaves petiolate; upper leaves sessile, narrowly oblong to oblanceolate, 2–6.5 × 0.5–1.5 cm, short strigose and sparsely bristly, base attenuate, apex usually subacute, sometimes obtuse. Inflorescences racemelike, 2–8 cm; bracts leaflike, linear to narrowly so, 0.8–2.5 cm × 1–3 mm. Pedicel ca. 0.8 mm. Calyx ca. 1.6 mm, to ca. 4.5 mm in fruit, parted nearly to base; lobes triangular, hirsute outside. Corolla purple-blue or white, glabrous; tube ca. 1 mm; appendages low trapeziform, ca. 0.3 mm; limb 2–3 mm wide; lobes orbicular-ovate. Nutlets narrowly ovoid, 2–2.2 × ca. 1.2 mm, with few fine tubercles and short hairs; aperture triangular, 1.2–1.5 mm, membranous emergence inside margin, ca. 0.3 mm; attachment scar near base. Fl. Jun–Sep.

• Sandy areas, marshes, gravelly slopes, field margins, forests; 2200–4200 m. NW and SW Gansu, E and S Qinghai, E Xizang.

**28. *Microula tangutica*** Maximowicz, Bull. Acad. Imp. Sci. Saint Pétersbourg 26: 500. 1880.

宽苞微孔草 kun bao wei kong cao

Stems single or several, frequently branched in lower part, 3–7 cm tall, spreading pubescent. Basal and lower stem leaves petiolate, spatulate, ca. 3 cm × 4–10(–14) mm, pubescent, base attenuate, apex rounded and obtuse; middle and upper stem leaves sessile, spatulate to elliptic, 0.9–1.4 cm. Inflorescences terminal, few flowered; bracts crowded, broadly ovate, orbicular-ovate, to suborbicular, 3–8 × 3–6 mm. Calyx ca. 1.2 mm, to 2 mm in fruit, parted nearly to base; lobes narrowly triangular, short strigose inside, margin villous. Corolla blue or white, glabrous; tube ca. 1.1 mm; appendages lunate, ca. 0.2 mm; limb ca. 2.2 mm wide; lobes orbicular. Nutlets suboblique, ca. 1.8 × 1.2 mm, glabrous, with few fine tubercles, abaxially with 3 obscure longitudinal ribs, without aperture; attachment scar above adaxially. Fl. Jul–Sep.

• Alpine meadows, gravelly slopes; 3600–5200 m. Gansu (Tianzhu Xian), E and S Qinghai, NE Xizang.

**29. *Microula tibetica*** Benth in Benth & J. D. Hooker, Gen. Pl. 2: 853. 1876.

西藏微孔草 xi zang wei kong cao

Herbs ca. 1 cm tall, sparsely short hispid or subglabrous. Branches very short and crowded in middle of conspicuous leaf rosette. Leaves prostrate, spatulate, 3–13 × 0.8–2.8 cm, abaxially short white bristly, hairs discoid at base, adaxially sparser and short strigose, base attenuate into petiole, margin subentire or undulate, apex rounded to obtuse. Inflorescences

terminal, very crowded and forming dense headlike cluster; bracts linear to oblong-linear, 0.2–2 cm, short pubescent, adaxially with intermixed short bristles. Pedicel less than 0.8 mm, elongated to 5 mm, pendulous in fruit, stout, sparsely short hispid. Calyx ca. 1.5 mm, to 3 mm in fruit; lobes narrowly triangular, sparsely pubescent outside, ciliate along margin. Corolla blue or white, glabrous; tube ca. 1.2 mm; appendages low trapeziform, ca. 0.3 mm; limb 1.2–4 mm wide; lobes orbicular-ovate. Nutlets ovate to subrhombic, 2–2.5 × 1.6–2 mm, finely tuberculate with glochids on tubercles or not tuberculate, with or without aperture; attachment scar at middle or slightly above adaxially.

Lakeshore marshes, disturbed slopes and roadsides, rocky areas, meadows; 3500–5300 m. Qinghai, Xinjiang, Xizang [India, Nepal].

- 1a. Corolla limb 1.2–1.8 mm wide; nutlets with abaxial aperture ..... 29c. var. *pratensis*
- 1b. Corolla limb 3.2–4 mm wide; nutlets without abaxial aperture.
  - 2a. Nutlets tuberculate ..... 29a. var. *tibetica*
  - 2b. Nutlets not tuberculate ..... 29b. var. *laevis*

**29a. *Microula tibetica* var. *tibetica***

西藏微孔草 (原变种) xi zang wei kong cao (yuan bian zhong)

*Microula benthamii* C. B. Clarke.

Corolla limb 3.2–4 mm wide. Nutlets tuberculate, without aperture. Fl. Jul–Sep.

Sandy marshes on lakeshores, sandy slopes, plateau meadows; 4500–5300 m. Xizang [N India, Nepal].

**29b. *Microula tibetica* var. *laevis*** W. T. Wang, Acta Phytotax. Sin. 18: 115. 1980.

光果西藏微孔草 guang guo xi zang wei kong cao

Corolla limb 3.2–4 mm wide. Nutlets not tuberculate, without aperture.

• Sandy slopes, rocky areas; 4900–5200 m. Xizang.

**29c. *Microula tibetica* var. *pratensis*** (Maximowicz) W. T. Wang, Acta Phytotax. Sin. 18: 115. 1980.

小花西藏微孔草 xiao hua xi zang wei kong cao

*Tretocarya pratensis* Maximowicz, Bull. Acad. Imp. Sci. Saint Pétersbourg 27: 505. 1881.

Corolla limb 1.2–1.8 mm wide. Nutlets tuberculate, aperture present, at center, elliptic to orbicular, ca. 0.5 mm.

• Open disturbed soil, often along roads and slopes, marshes, meadows; 3500–5300 m. Qinghai, Xinjiang, S Xizang.

## 31. ACTINOCARYA Benth in Benth & J. D. Hooker, Gen. Pl. 2: 846. 1876.

锚刺果属 mao ci guo shu

*Glochidocaryum* W. T. Wang.

Herbs annual. Stems slender, diffuse, sparsely short strigose or subglabrous. Leaves alternate, ovate-oblong to spatulate. Pedicel thin. Flowers solitary, axillary. Calyx 5-parted, slightly enlarged in fruit, spreading. Corolla rotate-campanulate; throat appendages 5; lobes of limb spreading, 5. Stamens inserted in corolla tube, included. Ovary 4-parted. Style not exerted; stigma subcapitate. Gynobase somewhat convex. Nutlets 4, narrowly ovoid, with glochids, abaxially convex, with some glochids confluent at base to form a cupular or crownlike emergence; attachment scar adaxially.

One species: China, India.

**1. Actinocarya tibetica** Benth in Benth & J. D. Hooker, Gen. Pl. 2: 846. 1876.

锚刺果 mao ci guo

*Actinocarya kansuensis* (W. T. Wang) W. T. Wang; *Glochidocaryum kansuense* W. T. Wang; *Hackelia minima* Brand.

Stems caespitose, 3–10 cm tall, sparsely short appressed pubescent upward, subglabrous below. Basal leaves oblanceolate to spatulate, 1.2–2.4 cm × 1.5–4.5 mm, abaxially sparsely short appressed pubescent, adaxially glabrous, base

attenuate, apex rounded, mucronate; stem leaves smaller. Pedicel to 1 cm. Flowers solitary in leaf axils. Calyx ca. 1.5 mm; lobes narrowly lanceolate, ca. as long as corolla tube, short appressed pubescent outside. Corolla white or light blue; tube ca. 1.3 mm; throat appendages slightly 2-cleft; lobes suborbicular, ca. 0.8 mm. Stamens inserted at middle of corolla tube; anthers ovoid. Nutlets narrowly obovate, 1.5–2 mm, with glochids 0.4–0.8 mm, short hispid, with cupular or crownlike emergences. Fl. and fr. Jul-Aug.

Meadows, marshes, thickets. SW Gansu, SE Qinghai, Xizang [N India].

### 32. METAERITRICHIMUM W. T. Wang, Acta Phytotax. Sin. 18: 514. 1980.

颈果草属 jing guo cao shu

Herbs annual. Flowers solitary, axillary. Calyx 5-parted nearly to base; lobes lanceolate, slightly elongated in fruit. Corolla campanulate-tubular; tube somewhat longer than limb; limb 5-parted; lobes overlapping, suborbicular, with small appendages. Stamens inserted at middle of corolla tube, included; anthers ovate-triangular; filaments short. Ovary 4-parted. Style reaching middle of corolla; stigma depressed globose. Gynobase flat. Nutlets 4, horizontally rotate spreading from gynobase, dorsiventrally compressed, ovoid, marginal rib with triangular glochids, margin with smaller glochids; large prickles confluent into a broad wing; attachment scar apical.

One species: endemic to China.

Flower construction, nutlet morphology, and marginal glochids indicate that *Metaeritrichium* is closely related to *Eritrichium*, but it differs in having a flat gynobase and rotate-spreading nutlets with apical attachment scars. The gynobase, habit, and pollen grain morphology are similar to those of *Microula*, but *Metaeritrichium* differs in having nutlets with prickly marginal ribs and apical attachment scar.

**1. Metaeritrichium microuloides** W. T. Wang, Acta Phytotax. Sin. 18: 515. 1980.

颈果草 jing guo cao

Herbs annual. Stems branched from base, diffuse, fleshy, depressed, to 3 mm in diam., 3–5 cm tall. Petiole complanate, 1–1.5 cm; leaf blade spatulate, broadly elliptic to ovate-lanceolate, 1–2 cm × 5–8 mm, abaxially sparsely short hispid, adaxially glabrous or sparsely pubescent. Flowers solitary, axillary or extra-axillary. Pedicel short, to 2 cm in fruit. Calyx blue-green; lobes lanceolate, ca. 1.5 × 0.5 mm, to 2 × 1.2 mm

in fruit, appressed pubescent above inside, sparsely pubescent or glabrous outside. Corolla purple-blue, campanulate-tubular; tube 0.8–1 mm; lobes suborbicular, ca. 0.5 mm; appendages transversely half elliptic, ca. 0.1 × 0.4 mm. Anthers ovate-triangular, ca. 0.3 mm. Gynobase flat. Nutlets dorsiventrally compressed, sparsely pubescent or glabrous, ca. 2 × 1.2 mm excluding marginal glochids, abaxial disc ovate; marginal glochids triangular, 0.8–1 mm, base confluent into a broad wing, apex anchorlike. Fl. and fr. Jul-Aug.

• Sand flats along streams and marshes, alpine meadows, talus slopes near mountain summits, alluvial terraces; 4300–5000 m. Qinghai, Xizang.

### 33. LAPPULA Moench, Methodus 416. 1794.

鹤虱属 he shi shu

*Echinospermum* Sweet ex Lehmann.

Plants annual or biennial, rarely perennial, pilose, strigose, rarely sericeous throughout, hairs tuberclelike or discoid at base. Leaves alternate. Inflorescence a drepanium, elongated after anthesis, bracteate. Calyx 5-parted nearly to base; lobes frequently enlarged in fruit. Corolla light blue, rarely white, campanulate or low salverform; tube short; throat appendages 5, trapeziform; limb 5-parted. Stamens included. Ovary globose, 4-parted. Style not exerted; stigma capitate. Gynobase subulate veined, ca. as long as or surpassing nutlets, rarely shorter. Nutlets 4, adherent to gynobase by entire adaxial rib or only by rib base, erect, homomorphic or heteromorphic; margin of abaxial surface usually with 1(–3) rows of glochids; bases of glochids separated



- finely tuberculate.
- 22a. Heteromorphic nutlets present, 2 with short glochids, 2 with longer glochids; homomorphic nutlets sometimes also present.
- 23a. All nutlets heteromorphic, disc and adaxial surface smooth ..... 16. *L. karelinii*
- 23b. Nutlets in lower part of inflorescences homomorphic, disc and adaxial surface tuberculate ..... 13. *L. duplicicarpa*
- 22b. All nutlets homomorphic.
- 24a. Marginal glochids slender, 0.5–0.9 mm ..... 9. *L. tenuis*
- 24b. Marginal glochids 1–2.5(–4.5) mm.
- 25a. Marginal glochids 1–2 mm; plants branched mainly on upper part of stems.
- 26a. Plants 25–40(–50) cm high; marginal spines 1–1.2 mm, disc not keeled ..... 8. *L. intermedia*
- 26b. Plants 15–20(–30) cm high; marginal spines ca. 1.5 mm, disc with protruding keel ..... 7. *L. stricta*
- 25b. Marginal glochids 2–2.5(–4.5) mm; plants usually branched basally.
- 27a. Marginal glochids hollow, terete ..... 36. *L. physacantha*
- 27b. Marginal glochids solid, or subglobose.
- 28a. Pedicel 1.5–4 mm, usually curved; nutlets 3.5–4 mm excluding prickles ..... 12. *L. semiglabra*
- 28b. Pedicel to 1 mm, straight; nutlets ca. 3 mm excluding prickles ..... 14. *L. patula*
- 18b. Disc margin of nutlets with 2 or 3 rows of glochids.
- 29a. Perennial herbs; stems several, 7–15 cm tall, ascending; basal leaves numerous, forming a rosette; glochids on disc 0.2–0.5 mm.
- 30a. Herbs silvery sericeous; basal leaves linear to filiform, to 4 cm × 1–2 mm; corolla ca. 5 mm; center line of disc of nutlet without glochids ..... 20. *L. sericata*
- 30b. Herbs green-gray pilose; basal leaves spatulate, to 3 cm × 2–4 mm; corolla 2–2.5 mm; center line of disc of nutlet with glochids ..... 21. *L. himalayensis*
- 29b. Biennial or annual herbs; stems few, usually 30–45 cm tall; basal leaves few, rarely forming a rosette; glochids on disc 1–3 mm, rarely smaller.
- 31a. Biennial herbs; corolla with spreading limb, 4–6(–8) mm across.
- 32a. About 2/3 of adaxial angle of nutlets affixed to gynobase; gynobase longer than nutlets ..... 25. *L. ramulosa*
- 32b. Entire adaxial angle of nutlets affixed to gynobase; gynobase shorter than nutlets.
- 33a. Corolla sky blue, limb to 6–8 mm across, throat appendages blue or dark blue ..... 22. *L. tianschanica*
- 33b. Corolla blue, limb to 4–5 mm across, throat appendages white, yellowish in herbarium specimens.
- 34a. Glochids on disc numerous but short, glochids of main row on margin of disc 1–1.5 mm; herbs to 30(–35) cm tall ..... 24. *L. pratensis*
- 34b. Glochids on disc usually 3 along center line, to 1 mm, glochids of main row on margin of disc 1.5–2.5 mm; herbs to 40–45 cm tall ..... 23. *L. tadshikorum*
- 31b. Annual herbs; corolla with campanulate limb, 2–3.5(–4) mm across.
- 35a. Calyx lobes stellate spreading in fruit, elongated to at least 7–8 mm; leaves light green or green, with sparse spreading hairs on large white tubercles; main marginal glochids with large anchorlike tip ..... 8. *L. intermedia*
- 35b. Calyx lobes spreading in fruit, not stellate, elongated to 4–5 mm; leaves usually densely appressed pubescent, grayish green; marginal glochids with small anchorlike tip.
- 36a. Upper part of nutlets separated by deep oval or elliptic pit; style protruding above nutlets (excluding glochids) 0.5–1 mm ..... 26. *L. consanguinea*
- 36b. Upper part of nutlets without pit; style protruding above nutlets to 0.2–0.3 mm.
- 37a. Main marginal prickles widened basally, confluent near

- base, 0.4–1.5(–2) mm ..... 18. *L. shanhsiensis*  
 37b. Main marginal prickles all separated, 1.5–2 mm (or more)  
 ..... 17. *L. myosotis*

**1. *Lappula spinocarpos*** (Forsskål) Ascherson ex Kuntze, Trudy Imp. S.-Peterburgsk. Bot. Sada 10: 215. 1884.

石果鹤虱 shi guo he shi

*Anchusa spinocarpos* Forsskål, Fl. Aegypt.-Arab. 41. 1775; *Echinosperrum spinocarpos* (Forsskål) Boissier; *E. vahlianum* Lehmann; *Sclerocaryopsis spinocarpos* (Forsskål) Brand.

Herbs annual. Stems erect, frequently branched from base or above middle, 3–12 cm tall, densely short appressed white pubescent; branches ascending. Basal leaves grayish green, spatulate-linear, to 3 cm × 4 mm, strigose, hairs discoid at base, base attenuate, apex obtuse; stem leaves smaller. Pedicel short, stout. Calyx lobes 3–4 mm, to 5–6 mm in fruit, minutely hispid. Corolla blue-purple, 3–4 mm; limb appendaged below throat. Gynobase subulate, surpassing nutlets by ca. 1.5 mm. Style short, exceeding gynobase. Nutlets gray-white, ovoid, 3.5–4 mm, pericarp firm, shiny; adaxially coherent to gynobase by entire rib, not easily separated; disc expanded at base, lower part with a few rudimentary glochids. Fl. May-Jun, fr. Jun-Jul.

Marshes, *Anabasis* and *Nanophyton* thickets, occasionally mountain terraces. Xinjiang (Zhungeer Basin) [Afghanistan, Kazakhstan, Kyrgyzstan, Pakistan, Russia, Tajikistan, Turkmenistan, Uzbekistan; N Africa, SW and W Asia, E Europe].

**2. *Lappula sinaica*** (de Candolle) Ascherson & Schweinfurth, Mem. Inst. Egypt 2: 111. 1887.

短萼鹤虱 duan e he shi

*Echinosperrum sinaicum* de Candolle in A. de Candolle, Prodr. 10: 141. 1846; *E. divaricatum* Bunge, *E. kotschyii* Boissier.

Herbs annual. Stems erect or ascending, frequently branched from base, 15–40 cm tall, gray strigose or hispid, hairs white, tuberclelike at base. Basal leaves petiolate, oblong to oblong-lanceolate, 1.5–5 × 0.5–1.5 cm, sparsely short hispid, base attenuate, margin entire, apex obtuse; stem leaves sessile, shorter, narrower. Inflorescences elongated in fruit, usually 1- or 2-bracted. Fruiting pedicel erect, stout, 2–3 mm. Calyx lobes erect, oblong to linear, 1.5–2.5 mm, short hispid, hairs discoid at base, not enlarged in fruit, shorter than nutlets, subtending base of fruit. Corolla light blue, campanulate, ca. 3 mm; limb 2.5–3 mm wide. Gynobase surpassing nutlets by ca. 1 mm. Nutlets 2.5–3.5 mm; disc narrowly oblong, densely granulose, margin prominent becoming a narrow rib, with a single sparse row of extremely short glochids or sometimes finely tuberculate; lateral surfaces tuberculate.

Fields, waste places. Xinjiang [Afghanistan, NW India, Kazakhstan, Kyrgyzstan, Pakistan, Russia, Tajikistan, Turkmenistan, Uzbekistan; NE Africa, SW Asia].

**3. *Lappula occultata*** Popov, Bot. Mater. Gerb. Bot. Inst. Komarova Akad. Nauk SSSR 14: 331. 1951.

隱果鹤虱 yin guo he shi

*Lappula sinaica* (A. de Candolle) Ascherson & Schweinfurth var. *occultata* (Popov) Pavlov.

Herbs annual. Stems erect, frequently branched above, 30–40 cm tall, gray strigose. Basal leaves narrowly spatulate to oblanceolate, 3–7 cm × 3–5 mm, sparsely short gray strigose, base attenuate into a long petiole, apex obtuse; stem leaves sessile, linear-lanceolate to oblong, sometimes flexed along midvein. Inflorescences to 7–18 cm in fruit; bracts linear, shorter than nutlets. Fruiting pedicel erect, 2–5 mm. Calyx lobes erect, linear, 3–3.5 mm, to 4 mm in fruit, enclosing nutlets. Corolla light blue; tube slightly longer than calyx; throat appendages trapeziform, 0.6–0.8 mm; limb 5-parted; lobes spreading horizontally, 5–6 mm wide. Gynobase surpassing nutlets by ca. 0.5 mm. Fruit 2.5–3 mm, apex truncate; nutlets ovoid, shiny; disc oblong-ovate, densely rounded granulose, center line keeled, margin prominent and forming a narrow rib; lateral surfaces granular.

Exposed, rocky slopes; ca. 1400 m. Xinjiang (Yuli Xian) [Kazakhstan, Kyrgyzstan, Mongolia, Russia, Tajikistan, Turkmenistan, Uzbekistan].

**4. *Lappula balchaschensis*** Popov ex Pavlov, Bot. Zhurn. SSSR 30(4): 190. 1945.

密枝鹤虱 mi zhi he shi

Herbs annual, much branched, crowded, becoming globose, 4–8 cm tall, densely spreading white hispid. Basal leaves forming a rosette; leaf blade spatulate, ca. 1.5 mm, base attenuate into a long petiole, apex rounded; stem leaves linear-lanceolate, rarely spatulate, 2–2.5 cm × ca. 3 mm, spreading white hirsute, apex obtuse to mucronate. Inflorescences terminal, short, crowded; bracts linear-lanceolate. Fruiting pedicel ca. as long as calyx or slightly shorter, erect to somewhat ascending. Calyx 5-parted; lobes oblong-linear, ca. 2 mm, to 3.5 mm in fruit, subtending nutlets. Corolla light blue, campanulate, 2.5–3 mm; tube ca. as long as calyx; limb ca. 1 mm wide; lobes vertical, suborbicular. Gynobase ca. as long as nutlets. Fruit subglobose, 2.5–3 mm; nutlets narrowly ovoid; adaxially shiny, wrinkled; disc narrow, small, white granulose; margin thick, prominent, ca. 0.5 mm wide, usually revolute, with a single row of glochids 3 or 4 each side; basal pair of glochids ca. 1 mm, spreading outward, slightly widened at base.

Deserts, semideserts; ca. 1400 m. Xinjiang (Turpan Xian) [Kazakhstan, Kyrgyzstan, Mongolia, Russia, Tajikistan, Turkmenistan, Uzbekistan].

**5. *Lappula deserticola*** C. J. Wang, Bull. Bot. Res., Harbin 1(4): 81. 1981.

沙生鹤虱 sha sheng he shi

Herbs annual, densely cespitose, becoming depressed globose, 4–10 cm in diam. Stems usually several, cespitose, much branched at middle and above, 3–7 cm tall, densely

spreading white hispid. Basal leaves forming a rosette; leaf blade spatulate, 1–1.3 cm including petiole, densely spreading hirsute, hairs discoid at base; stem leaves linear, 1–1.5 cm × ca. 2.5 mm, flexed along midvein, rarely flat, densely spreading white hirsute, base attenuate, apex acute. Inflorescences terminal, to 1.5–3 cm in fruit; bracts oblong, 3–5 mm. Fruiting pedicel erect, 1–1.5 mm. Calyx lobes erect, linear-oblong, ca. 1.5 mm, to 2–2.5 mm in fruit, 1/2–2/3 shorter than fruit, spreading white hirsute. Corolla light blue, campanulate, ca. 2.5 mm; throat appendages trapeziform, ca. 0.2 mm; limb 1–1.5 mm wide; lobes oblong. Gynobase not surpassing nutlets. Fruit subglobose, ca. 3 mm in diam.; nutlets triangular-ovoid, 2.5–3 mm; adaxially shiny, coherent to gynobase along 1/2 rib; disc narrow, sparsely granulose, margin thickened, forming a riblike wing; wing involute, usually covering apex of disc, with 4 or 5 marginal glochids along each side; glochids widened at base but not contiguous, basal pair 1.5–2 mm, gradually reduced toward apex of nutlet, smooth. Fl. and fr. May–Jun.

• Deserts. Gansu (W Hexi Corridor), Nei Mongol (Alxa Youqi).

**6. *Lappula macra*** Popov ex Pavlov, Bot. Zhurn. SSSR 30(4): 190. 1954.

白花鹤虱 bai hua he shi

Herbs annual. Stems frequently branched from base, 15–20 cm tall, pubescent. Basal leaves linear-spatulate, ca. 1.5 cm × 3–4 mm, pubescent; stem leaves sessile, oblong-linear, 1–2 cm × 3–5 mm, abaxially densely minutely hispid, hairs discoid at base, adaxially glabrous or sparsely short hispid, apex obtuse. Inflorescences to 7 cm in fruit, lax; bracts linear to narrowly ovate, slightly longer than fruit. Fruiting pedicel 0.5–1.5 mm. Calyx 5-parted; lobes linear, short hispid, enlarged, ca. 3 mm, longer than fruit. Corolla white, narrowly campanulate, ca. 2 mm; limb shorter than tube. Style not surpassing nutlets. Nutlets narrowly triangular-ovoid, ca. 2 mm, adaxially glabrous or with a few tubercles at base; disc narrowly ovate, with 1(–3) rows of glochids or finely tuberculate on middle, with 1 row of marginal glochids 0.2–0.5 mm.

Deserts, arid slopes. Xinjiang [Kazakhstan, Mongolia].

**7. *Lappula stricta*** (Ledebour) Gürke in Engler & Prantl, Nat. Pflanzenfam. 4(3a): 107. 1897.

劲直鹤虱 jin zhi he shi

Herbs annual. Stems erect, usually branched below, 15–30 cm tall, spreading or subappressed, white hispid; branches ascending; stem leaves oblong to linear, 1–3.5 cm × 2–5 mm, spreading hirsute, hairs discoid at base, usually flexed along midvein, rarely flat, apex obtuse. Inflorescences terminal, to 5–8 cm in fruit; bracts linear. Fruiting pedicel ca. 3.3 mm, erect. Calyx 5-parted; lobes spreading, linear, ca. 2.5 mm, 4–5 mm in fruit. Corolla blue-purple, campanulate, ca. 3 mm; tube ca. as long as calyx; limb spreading horizontally, 2.5–3 mm wide. Style ca. 0.5 mm, slightly surpassing nutlets. Nutlets oblong-ovoid, ca. 3 mm, adaxially wrinkled-tuberculate; disc narrowly lanceolate, center line keeled, with a single row of marginal glochids; glochids erect, rarely spreading horizontally, 1.2–2 mm, somewhat widened and contiguous

toward nutlet base.

Roadsides, farms, hillside meadows, deserts, arid canyons. Gansu, Nei Mongol, Xinjiang [Kazakhstan, Kyrgyzstan, Mongolia, Tajikistan, Turkmenistan, Uzbekistan].

- 1a. Abaxial surface of nutlet granulose, adaxially wrinkled-tuberculate ..... 7a. var. *stricta*  
1b. Adaxial and abaxial surfaces of nutlet glabrous and shiny ..... 7b. var. *leiocarpa*

**7a. *Lappula stricta* var. *stricta***

劲直鹤虱 (原变种) jin zhi he shi (yuan bian zhong)

*Echinosperrum strictum* Ledebour, Fl. Altaic. 1: 200. 1829.

Adaxial surface of nutlets wrinkled-tuberculate, abaxially granulose.

Roadsides, farms, hillside meadows. Nei Mongol, Xinjiang [Kazakhstan, Kyrgyzstan, Mongolia, Russia, Tajikistan, Turkmenistan, Uzbekistan].

**7b. *Lappula stricta* var. *leiocarpa*** Popov in Komarov, Fl. URSS 19: 440. 1953.

平滑果劲直鹤虱 ping hua guo jin zhi he shi

Abaxial and adaxial surfaces of nutlets glabrous and shiny.

Deserts, arid canyons. Gansu (Minqin Xian), Xinjiang (Qinghe Xian) [Kazakhstan, Kyrgyzstan, Russia, Tajikistan, Turkmenistan, Uzbekistan].

**8. *Lappula intermedia*** (Ledebour) Popov in Komarov, Fl. URSS 19: 440. 1953.

蒙古鹤虱 meng gu he shi

*Echinosperrum intermedium* Ledebour, Fl. Altaic. 1: 199. 1829.

Herbs annual. Taproots stout, conical, ca. 7 cm. Stems erect, usually single, much branched above middle, to 60 cm tall, gray hispid; branches ascending; stem leaves somewhat crowded, erect, linear to narrowly lanceolate, 2–5 cm × 2–4 mm, flat or flexed along midvein, hirsute, hairs discoid at base, adaxially sparser, apex obtuse. Inflorescences terminal on stem and branches, to 5–20 cm in fruit; bracts leaflike, slightly longer than fruit, apex gradually reduced. Pedicel erect, slightly elongated after anthesis, 2–3 mm. Calyx 5-parted; lobes spreading, linear, ca. 3 mm, to 5 mm in fruit. Corolla blue-purple or light blue, campanulate, ca. 3–3.5 mm, somewhat longer than calyx; tube ca. 1 mm; throat constricted, appendages attached at middle of corolla tube; limb ca. 3 mm wide; lobes oblong. Style ca. 0.5 mm, not surpassing nutlets. Fruit broadly ovoid to subglobose, ca. 3 mm; nutlets broadly ovoid, 2.5–3 mm, granulose, adaxially wrinkled; disc ovate with a single row of marginal glochids; glochids spreading horizontally, 1–1.5 mm, bases slightly wider and contiguous or free. Fl. and fr. May–Aug.

Waste places, fields, grasslands, sandy areas, arid slopes. Gansu, Hebei, Heilongjiang, Jilin, Liaoning, Nei Mongol, Ningxia,

Qinghai, Shaanxi, Shandong, Shanxi, NW Sichuan, Xinjiang, Xizang [Kazakhstan, Kyrgyzstan, Mongolia, Russia, Tajikistan, Turkmenistan, Uzbekistan].

**9. *Lappula tenuis*** (Ledebour) Gürke in Engler & Prantl, Nat. Pflanzenfam. 4(3a): 107. 1897.

细刺鹤虱 xi ci he shi

*Echinosperrum tenue* Ledebour, Fl. Altaic. 1: 201. 1829.

Herbs annual. Stems slender, frequently branched above, 17–20 cm tall, spreading or appressed gray-green hispid; branches ascending. Leaf blade linear to linear-lanceolate, 1.5–3 cm × 2–4 mm, flat and erect, obtuse to ± acute, abaxially densely strigose, adaxially green, sparsely strigose. Inflorescences 4–6 cm in fruit; bracts linear, slightly longer than fruit. Fruiting pedicel 1–1.5 mm. Calyx 5-parted; lobes spreading, linear, ca. 2.5 mm, to 4 mm in fruit. Corolla light blue, ca. 3 mm, campanulate; limb 2.5–3 mm wide; lobes oblong, ca. 1 mm. Gynobase somewhat surpassing nutlets. Fruit ca. 2.5 mm; nutlets broadly ovoid, ca. 2 mm, adaxially granulate or smooth, glabrous or sparsely tuberculate at base; disc ovate, without keel, smooth or granulate; marginal glochids in a single row, 4–7 on each side, 0.6–1 mm, fine, free at base.

Sunny slopes, desert communities of *Haloxyton ammodendron* and *Anabasis aphylla*; ca. 1500 m. Xinjiang (N Zhungeer Basin) [Kazakhstan, Kyrgyzstan, Mongolia, Russia, Tajikistan, Turkmenistan, Uzbekistan].

**10. *Lappula microcarpa*** (Ledebour) Gürke in Engler & Prantl, Nat. Pflanzenfam. 4(3a): 107. 1897.

小果鹤虱 xiao guo he shi

*Echinosperrum microcarpum* Ledebour, Fl. Altaic. 1: 202. 1829; *E. oligacanthum* Ledebour; *E. stylosum* Karelin & Kirilov; *Lappula microcarpa* var. *heterogenea* X. D. Wang & C. J. Wang.

Herbs annual or biennial, erect. Stems much branched above middle, 20–45 cm tall, white strigose. Basal leaves forming a rosette, withered in fruit; leaf blade oblong, 3–4 cm, base attenuate, apex obtuse; stem leaves linear, 2–3 cm × 2–4 mm, flexed along midvein, gray-white hispid, hairs discoid at base, margin spreading ciliate. Inflorescences terminal on branches, elongated in fruit; bracts linear. Fruiting pedicel erect, ca. 2 mm. Calyx 5-parted; lobes linear, ca. 3 mm, not enlarged in fruit. Corolla light blue, campanulate, ca. 5 mm; tube slightly longer than calyx; limb ca. 4.5 mm wide; lobes ovate-orbicular. Style surpassing nutlets 0.8–1.5 mm. Nutlets ovoid, 2.5–3 mm; adaxially granulate, sometimes with 2 rows of glochids below; disc narrowly ovate, granulate, center line keeled and with short glochids; marginal glochids in a single row, 0.8–1 mm.  $2n = 22, 24$ .

Sunny slopes, low mountain canyons; 700–2500 m. N Xinjiang, S and SE Xizang [Afghanistan, N India, Kashmir, Kazakhstan, Kyrgyzstan, Mongolia, Nepal, Pakistan, Russia, Tajikistan, Turkmenistan, Uzbekistan; SW and W Asia].

**11. *Lappula brachycentra*** (Ledebour) Gürke in Engler & Prantl, Nat. Pflanzenfam. 4(3a): 107. 1897.

短刺鹤虱 duan ci he shi

*Echinosperrum brachycentrum* Ledebour, Fl. Altaic. 1: 203. 1829.

Herbs biennial, gray appressed pubescent. Taproots straight, dark brown. Stems much branched above middle, 20–35 cm tall. Basal leaves forming a rosette, mostly withered in fruit; leaf blade oblong to spatulate, 2–4 cm, abaxially densely gray appressed sericeous, adaxially green and sparsely long appressed pubescent, base attenuate into a short petiole, apex obtuse; stem leaves sessile, linear, 1–2.5 cm, margin spreading ciliate, apex obtuse. Inflorescences terminal on branches, elongated in fruit; bracts linear. Fruiting pedicel erect, 1–2 mm. Calyx 5-parted; lobes linear, ca. 2 mm, slightly enlarged in fruit. Corolla light blue; tube ca. 2 mm; limb ca. 4–5 mm wide; lobes ovate. Style surpassing nutlets, 1–1.5 mm. Fruit ovoid, ca. 2.5 mm; nutlets triangular-ovoid, adaxially granulate; abaxially granulate, sometimes obscurely keeled along center line; marginal glochids in 1 or 2 rows, protruding, ca. 0.5 mm.

Sunny slopes, arid terraces, semideserts, mountain meadows; 800–2800 m. Xinjiang [Kazakhstan, Kyrgyzstan, Russia, Tajikistan, Turkmenistan, Uzbekistan].

*Lappula ramulosa* C. J. Wang & X. D. Wang may be a synonym of *L. brachycentra*.

**12. *Lappula semiglabra*** (Ledebour) Gürke in Engler & Prantl, Nat. Pflanzenfam. 4(3a): 107. 1897.

狭果鹤虱 xia guo he shi

Herbs annual. Stems much branched, 15–30 cm tall, white hispid. Basal leaves numerous, forming a rosette, sessile, spatulate to narrowly oblong or linear-lanceolate, 2–3 cm × 2–4 mm, abaxially densely spreading white hispid, hairs discoid at base, adaxially glabrous or sometimes sparsely hispid, base attenuate, margin entire, apex obtuse; stem leaves narrowly oblong to oblanceolate. Inflorescences short at anthesis, to 12 cm in fruit; bracts lanceolate to narrowly ovate. Fruiting pedicel usually curved, ca. 3 mm. Flowers short pedicellate. Calyx 5-parted; lobes oblong, 1–1.5 mm, to 3 × 0.5 mm in fruit, hispid. Corolla light blue, campanulate, ca. 3 mm; limb ca. 2 mm wide; lobes obtuse. Gynobase not surpassing nutlets. Nutlets homomorphic or heteromorphic, narrowly lanceolate, 3–4 mm, adaxially tuberculate or glabrous; disc with scattered tubercles, center line keel usually with short prickles or tubercles; marginal glochids in a single row, bases slightly wider and contiguous. Fl. and fr. Jun-Sep.

Alluvial fans, gravelly slopes, dunes, deserts. Gansu, Qinghai, Xinjiang [Afghanistan, NW India, Kazakhstan, Kyrgyzstan, Mongolia, Pakistan, Russia, Tajikistan, Turkmenistan, Uzbekistan; SW Asia].

1a. Nutlets homomorphic ..... 12a. var. *semiglabra*  
1b. Nutlets heteromorphic ..... 12b. var. *heterocaryoides*

**12a. *Lappula semiglabra* var. *semiglabra***

狭果鹤虱 (原变种) xia guo he shi (yuan bian zhong)

*Echinosperrum semiglabrum* Ledebour, Fl. Altaic. 1: 204. 1829; *Lappula caspicum* Fischer & C. A. Meyer.

Nutlets homomorphic, marginal glochids 4–5 mm.

Alluvial fans, gravelly slopes, dunes, deserts. Gansu, Qinghai, Xinjiang [Afghanistan, NW India, Kazakhstan, Kyrgyzstan, Mongolia, Pakistan, Russia, Tajikistan, Turkmenistan, Uzbekistan; SW Asia].

**12b. *Lappula semiglabra* var. *heterocaryoides*** Popov ex C. J. Wang, Bull. Bot. Res., Harbin 1(4): 83. 1981.

异形狭果鹤虱 yi xing xiao guo he shi

Nutlets heteromorphic, 2 with marginal glochids 4–5 mm and 2 with marginal glochids 0.3–0.8 mm.

Alluvial fans, gravelly slopes, dunes, deserts. Gansu, Qinghai, Xinjiang [Kazakhstan, Kyrgyzstan, Russia, Tajikistan, Turkmenistan, Uzbekistan].

**13. *Lappula duplicicarpa*** Pavlov, Vestn. Akad. Nauk SSSR 5: 90. 1952.

两形果鹤虱 liang xing guo he shi

Herbs annual. Stems much branched above base, 15–30 cm tall, densely retrorse strigose or long hispid. Basal leaves sessile, linear-lanceolate, 0.8–2.5 cm × 2–6 mm, abaxially densely hispid, hairs discoid at base, adaxially glabrous or sparsely hispid, base attenuate, margin entire, apex obtuse. Inflorescences to 12 cm in fruit; bracts lanceolate to narrowly ovate. Fruiting pedicel ca. 3 mm, mostly curved. Calyx 5-parted, long retrorse strigose; lobes lanceolate, ca. 1.5 mm, to 2.5 mm in fruit. Corolla light blue, campanulate, 2–5 mm; limb 1.5–3.5 mm wide; lobes narrowly oblong to suborbicular, 0.5–2.5 mm. Style short, not surpassing nutlets. Nutlets homomorphic or both homomorphic and heteromorphic, oblong-ovoid, ca. 3 mm, adaxially tuberculate; disc tuberculate, narrowly ovate, center line with extremely short glochids; glochids 0.2–0.5 mm, bases complanate and contiguous.

Sunny slopes, rocky hills, sandy areas, deserts, desert marshes. Gansu, Qinghai, Xinjiang [Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan].

1a. Plants ca. 7 cm, whole plant pubescent; nutlets homomorphic .. 13c. var. *brevispinula*

1b. Plants 15–30 cm, mainly stems pubescent; nutlets dimorphic.

2a. Stems strigose; corolla 2–2.5 mm, limb 1.5–2 mm wide, lobes narrowly oblong, ca. 0.5 mm ..... 13a. var. *duplicicarpa*

2b. Stems densely long hispid; corolla ca. 5 mm, limb ca. 3.5 mm wide, lobes suborbicular, 2–2.5 mm ..... 13b. var. *densihispida*

**13a. *Lappula duplicicarpa* var. *duplicicarpa***

两形果鹤虱 (原变种) liang xing guo he shi (yuan bian zhong)

Plants branched from base, stems retrorse strigose. Corolla ca. 2.5 mm; limb 1.5–2 mm wide; lobes narrowly

oblong, ca. 0.5 mm. Nutlets of lower part of inflorescences homomorphic; nutlets of upper part heteromorphic, (1 or) 2 (or 3) nutlets with glochids 0.2–0.5 mm, other nutlet(s) with glochids 2–4 mm. Fl. and fr. Jun-Aug.

Sunny slopes, rocky hills, desert communities of *Haloxylon ammodendron* and *Anabasis salsa*. Qinghai (Golmud Xian), N Xinjiang [Kazakhstan, Kyrgyzstan, Russia, Tajikistan, Turkmenistan, Uzbekistan].

**13b. *Lappula duplicicarpa* var. *densihispida*** C. J. Wang, Bull. Bot. Res., Harbin 1(4): 83. 1981.

密毛两形果鹤虱 mi mao liang xing guo he shi

Plants branched from base, stems densely long hispid. Corolla ca. 5 mm; limb ca. 3.5 mm wide; lobes suborbicular, 2–2.5 mm. Nutlets of lower part of inflorescences with 4 homomorphic nutlets; nutlets of upper parts heteromorphic, (1 or) 2 (or 3) nutlets with glochids 0.2–0.5 mm, other nutlet(s) with glochids 2–4 mm. Fl. and fr. Jun-Aug.

• W Gansu (Ejina River Basin), N Xinjiang (Fuhai Xian).

**13c. *Lappula duplicicarpa* var. *brevispinula*** C. J. Wang, Bull. Bot. Res., Harbin 1(4): 84. 1981.

小刺两形果鹤虱 xiao ci liang xing guo he shi

Plants densely branched from base, ca. 7 cm, entire plant hispid. Nutlets homomorphic, disc with marginal glochids 0.2–0.5 mm, sometimes a few nutlets with glochids to 2 mm. Fl. and fr. May-Jul.

• Desert marshes, sandy areas; ca. 400 m. N Xinjiang (Burqin Xian).

**14. *Lappula patula*** (Lehmann) Ascherson ex Gürke in Engler & Prantl, Nat. Pflanzenfam. 4(3a): 107. 1897.

卵果鹤虱 luan guo he shi

*Echinosperrum patulum* Lehmann, Pl. Asperif. Nucif. 2: 124. 1818; *Lappula redowskii* (Hornemann) Greene var. *patula* (Lehmann) Nelson & J. F. Macbride; *Myosotis redowskii* Hornemann.

Herbs annual. Stems branched above middle, 20–35 cm tall, with finely appressed white hairs. Basal leaves forming a rosette, sessile; leaf blade linear to spatulate, 2.5–3 cm × 2–4 mm, spreading gray-white hispid, hairs discoid at base, adaxially more sparsely hispid, margin entire, apex obtuse; stem leaves similar to basal leaves, narrow, mostly linear, smaller. Inflorescences numerous, frequently secund, to 20(–23) cm in fruit; bracts leaflike, linear. Flowers sessile or short pedicellate. Calyx spreading hispid; lobes spreading, linear to narrowly oblong, 1–1.5 mm at anthesis, to 5 mm in fruit. Corolla light blue, campanulate, ca. 2.5 mm; limb 1.5–2 mm wide. Style ca. 0.5 mm, somewhat surpassing nutlets. Fruit orbicular-ovoid; nutlets homomorphic, ovoid, ca. 3 mm, base with 4 or 5 small prickles on each side; disc narrowly lanceolate, tuberculate, not keeled; marginal glochids in a single row, 1.5–2.5 mm, with slightly widened but free bases.

Waste places, field margins, valley terraces. N Xinjiang

[Afghanistan, NW India, Kazakhstan, Kyrgyzstan, Pakistan, Russia, Tajikistan, Turkmenistan, Uzbekistan; N Africa, SW Asia].

**15. *Lappula caespitosa*** C. J. Wang, Acta Phytotax. Sin. 18: 521. 1980.

密丛鹤虱 mi cong he shi

Herbs perennial. Taproots brown, straight, stout. Stems 4 to numerous, caespitose, branched above, 11–18 cm tall, brownish below, stiff, slightly spreading gray-white villous; branches ascending. Basal leaves numerous, forming a rosette, frequently persistent in withered state, sessile; leaf blade linear-spatulate to linear, 1–3 cm × 1.5–3 mm, flat or longitudinally flexed, densely gray-white villous, base attenuate, apex obtuse; stem leaves linear-spatulate to linear, 1–2 cm × 1–1.5 mm. Inflorescences 2–5 cm in fruit; bracts linear, 3–5 mm. Pedicel 1.5–2 mm. Calyx 5-parted; lobes erect, linear, ca. 2.5 mm in fruit, densely villous. Corolla light blue, campanulate, 3–3.5 mm; tube ca. as long as calyx; throat appendages 5, trapeziform; limb 2–2.5 mm wide; lobes obovate. Anthers oblong, inserted on middle of corolla tube. Style slightly surpassing nutlets, not surpassing upper prickles of nutlets; stigma subglobose. Fruit ovoid; nutlets narrowly ovoid, 2.5–3 mm, adaxially wrinkled or glabrous; disc lanceolate, sparsely finely white granulose; marginal glochids in a single row, 1–1.5 mm, bases slightly widened, not contiguous. Fl. and fr. Jun-Aug.

• Alluvial, sandy, gravelly areas, arid ravines; ca. 4200 m. SW Xizang.

*Lappula caespitosa* is probably identical to *L. alata* (Popov) Goloskokov (Fl. Pl. Resour. Kazhakstan 78. 1975).

**16. *Lappula karelinii*** (Fischer & C. A. Meyer) Kamelin, Novon 3: 263. 1993.

光胖鹤虱 guang pan he shi

*Echinosperrum karelinii* Fischer & C. A. Meyer, Ind. Sem. Hort. Petrop. 11: 67. 1845; *Lappula xinjiangensis* C. Y. Yang ex C. J. Wang.

Herbs biennial, densely caespitose. Taproots conical, stout, to 8 cm. Stems numerous, short branched above, 11–15 cm tall, gray-white pilose. Basal leaves numerous, forming a rosette, frequently persistent in withered state; petiole 1–1.5 cm; leaf blade spatulate to linear, 0.5–1.5 cm × 5–7 mm, abaxially densely gray-white pilose, adaxially glabrous or pubescent, dark green, base attenuate, apex rounded and emarginate; stem leaves sessile, linear, 1–2.5 cm × 1.5–2 mm. Inflorescences terminal on branches, many flowered. Pedicel ca. 2 mm; bracts oblong, ca. 3 mm, somewhat shorter than fruit. Flowers crowded. Calyx 5-parted; lobes oblong, to 1.5 mm in fruit, much shorter than nutlets. Corolla campanulate, 1.5–2 mm; tube 1–1.5 mm; limb 1–1.5 mm wide; lobes obovate, ca. 0.5 mm. Style not surpassing nutlets; stigma capitate. Fruit light yellow, 2.5–3 mm. Nutlets heteromorphic, ovoid, glabrous, shiny; disc narrowly ovate, frequently dark greenish; marginal glochids in a single row, 2–2.5 mm on 2 nutlets and 0.3–0.5 mm, lanceolate on other nutlets. Fl. and fr. May-Aug.

• Sandy river banks; ca. 400 m. Xinjiang (Burqin Xian).

**17. *Lappula myosotis*** Moench, Methodus 417. 1794.

鹤虱 he shi

*Myosotis lappula* Linnaeus, Sp. Pl. 1: 131. 1753; *Echinosperrum lappula* (Linnaeus) Lehmann; *Lappula echinata* Gilibert.

Herbs annual or biennial. Stems erect, much branched, 30–60 cm tall, densely short white hispid. Basal leaves oblong-spatulate, densely white hirsute, hairs discoid at base, base attenuate to long petiole, to ca. 7 cm × 3–9 mm (including petiole), margin entire, apex obtuse; stem leaves sessile, lanceolate to linear, shorter, narrower, flat or longitudinally flexed along midvein, base attenuate, apex acute. Inflorescences to 17 cm in fruit; bracts linear, slightly longer than fruit. Pedicel erect, ca. 3 mm in fruit, pubescent. Calyx lobes spreading or reflexed, linear, 2–3 mm at anthesis, to 5 mm in fruit, becoming lanceolate, pubescent, apex acute. Corolla light blue, funnelliform to campanulate, ca. 4 mm; throat appendages trapeziform; limb 3–4 mm wide; lobes oblong-ovate. Style surpassing nutlets but not apical prickles. Nutlets ovoid, 3–4 mm, adaxially with spiny emergences or tuberculate; disc narrowly ovate to oblong-lanceolate, usually granulose, rarely smooth or keeled, with fine spiny emergences along center line; marginal glochids in 2 rows; inner glochids 1.5–2 mm, separated at base; outer row of glochids slightly shorter, usually erect. Fl. and fr. Jun-Sep. 2n = 48.

Hillside meadows. Gansu, Hebei, W Nei Mongol, Ningxia, Qinghai, Shaanxi, Shandong, Shanxi, Xinjiang [NW Afghanistan, Kazakhstan, Kyrgyzstan, Mongolia, Pakistan, Russia, Tajikistan, Turkmenistan, Uzbekistan; S Africa, SW Asia, C and E Europe, North America].

The fruit are used as an antiphlogistic and insecticide in Heilongjiang, Jilin, Liaoning, Ningxia, and Xinjiang.

**18. *Lappula shanhsiensis*** Kitagawa, Acta Phytotax. Geobot. 20: 48. 1962.

山西鹤虱 shan xi he shi

Herbs annual. Taproot dark brown, terete. Stems erect or ascending below, much branched from base or apex, 15–45 cm tall, sparsely spreading villous, densely appressed short white pubescent. Leaves sessile, linear-spatulate to linear-oblong, 2–4(–5) cm × 2–5 mm, densely appressed white villous, hairs inflated leathery discoid at base, base attenuate, margin entire, villous, apex obtuse. Inflorescences on stem branches, to 20–25 cm in fruit; bracts leaflike, linear-lanceolate to narrowly lanceolate, 0.8–2.5 cm × 1.5–6 mm, base attenuate to rotund, apex ± acute. Flowers opposite. Pedicel 1.5–2 mm, to 3–5 mm in fruit. Calyx 2–2.5 mm; lobes linear-lanceolate, to 5 mm in fruit, villous outside, sparsely short pubescent inside. Corolla blue, 2.5–3 mm; tube ca. 2 mm, ca. as long as calyx; throat appendages trapeziform, ca. 0.3 mm; lobes of limb elliptic, ca. 1 mm. Anthers broadly ovoid, ca. 3 mm. Style surpassing nutlets, ca. 0.3 mm. Nutlets broadly ovoid, ca. 3 mm, with milky white tubercles; disc ovate-triangular; marginal glochids in (1 or) 2 rows; inner

glochids 0.4–2 mm, base somewhat widened, confluent, rarely free, frequently with short fine glochids between them; outer glochids 0.2–0.5 mm. Fl. and fr. Jun-Sep.

• Hillside meadows, fields near villages. Gansu, Hebei, Nei Mongol, Shanxi, Xizang.

**19. *Lappula granulata*** (Krylov) Popov in Komarov, Fl. URSS 19: 426. 1953.

粒状鹤虱 li zhuang he shi

*Lappula marginata* (M. Bieberstein) Gürke var. *granulata* Krylov, Fl. Zap./West Sib. 9: 2248. 1937; *L. gansuensis* X. D. Wang & C. J. Wang; *L. platyacantha* W. T. Wang ex C. J. Wang.

Herbs annual. Stems erect, branched above, 30–50 cm tall, spreading or subappressed gray pilose. Basal leaves forming a rosette; leaf blade oblong, 2–7 cm × 3–8 mm, spreading or slightly spreading gray hispid, hairs discoid at base, base attenuate, margin entire, apex obtuse; stem leaves sessile, shorter, narrower. Inflorescences widely spaced, strongly elongated in fruit; bracts linear, longer than fruit on lower part of inflorescences. Pedicel erect, elongated in fruit, 3–5 mm on lower part of inflorescence, stout above, thin at base; pubescent. Calyx lobes erect at anthesis, often spreading in fruit, linear, 2–3 mm, to 5 mm in fruit. Corolla light blue, campanulate, 3–3.5 mm; throat white or light yellow, appendages trapeziform; limb 2–4 mm wide. Style not surpassing upper prickles of nutlets. Nutlets ovoid, 3–3.5 mm, adaxially tuberculate; disc oblong-lanceolate, finely tuberculate; marginal glochids in 2 rows; inner glochids yellow, 1.5–2 mm, bases expanded and confluent into a narrow wing; outer glochids 0.5–1 mm, usually only on lower part. Fl. and fr. Jun-Sep.

Meadows, hillsides, fields on loess plateau, margins of cultivated land. Gansu, Hebei, Heilongjiang, Jilin, Liaoning, Nei Mongol, Ningxia, Shaanxi, Shandong, Shanxi [Kazakhstan, Mongolia].

The fruit are used as an antiphlogistic and insecticide in NE China.

**20. *Lappula sericata*** Popov, Bot. Mater. Gerb. Bot. Inst. Komarova Akad. Nauk SSSR 14: 320. 1951.

绢毛鹤虱 juan mao he shi

Herbs perennial or biennial, densely caespitose. Stems usually 4–10, ascending or diffuse, branched above, 7–15 cm tall, densely gray-white sericeous. Basal leaves numerous, forming a rosette, sessile; leaf blade linear to filiform, to 4 cm × 1–2 mm, apex obtuse; stem leaves similar to basal leaves, 0.5–1.5 mm. Inflorescences terminal on branches, 3–6 cm in fruit; bracts linear, usually ca. as long as fruiting pedicel. Fruiting pedicel erect, stout, 1.5–2 mm. Calyx 5-parted; lobes linear, densely sericeous, 2–2.5 mm in fruit, subtending fruit. Corolla blue; tube ca. 2 mm; throat appendages trapeziform, ca. 0.6 mm; limb ca. 5 mm wide; lobes oblong, 1.5–2 mm. Style surpassing nutlets by 0.3–0.5 mm. Fruit ovoid-globose, ca. 2.5 mm; nutlets ovoid, 2–2.5 mm, densely granulate with spines; disc ovate; marginal glochids in 2 rows, inner glochids 0.2–0.5 mm, base erect or curved, outer glochids ca. 0.2

mm.

Hillsides. Xinjiang (Yuli Xian) [Kazakhstan, Kyrgyzstan, Russia, Tajikistan, Turkmenistan, Uzbekistan].

**21. *Lappula himalayensis*** C. J. Wang, Acta. Phytotax. Sin. 18: 521. 1980.

喜马拉雅鹤虱 xi ma la ya he shi

Herbs annual. Main roots black-brown, straight, terete. Stems 4–6, caespitose, ascending or erect, branched above, 7–15 cm tall, densely appressed pubescent; branches spreading. Basal leaves forming a rosette, sessile; leaf blade linear-spatulate to linear, 2–3 cm × 2–4 mm, longitudinally flexed along midvein, pubescent, adaxially with fewer hairs, base attenuate, apex obtuse; stem leaves similar to basal leaves, narrower, shorter. Inflorescences terminal on branches, 3–7 cm in fruit; lower bracts similar to stem leaves; upper bracts linear, slightly shorter than fruit. Fruiting pedicel erect, 1.5–2 mm. Calyx lobes linear, ca. 1.5 mm, pubescent outside, enlarged in fruit, usually shorter than nutlets. Corolla light blue, campanulate; tube ca. 1 mm; limb 2–2.5 mm wide; throat appendages trapeziform, ca. 0.5 mm; lobes oblong to obovate. Style surpassing nutlets by 0.5 mm. Nutlets ovoid, ca. 2.5 mm, densely granulate, disc with 3 or 4 short glochids along center line; marginal glochids in 2 rows; inner glochids 0.5–0.8 mm, often curved; outer glochids ca. 0.2 mm. Fl. and fr. Jun-Aug.

• Hillsides; 3700–4200 m. S Xizang.

**22. *Lappula tianschanica*** Popov & Zakirov, Bot. Mater. Gerb. Bot. Inst. Komarova Akad. Nauk SSSR 14: 317. 1951.

天山鹤虱 tian shan he shi

Herbs biennial or perennial. Stems usually single, erect, much branched above, 40–60 cm tall, densely gray-white strigose. Basal leaves numerous, lanceolate to spatulate, 5–8 cm, withered in fruit; stem leaves lanceolate to linear-lanceolate, 3–6 cm × 4–10 mm, flat, sparsely hirsute, hairs discoid at base, sometimes densely light gray pilose, apex ± acute. Inflorescences widely spaced, 10–15 cm, elongated and secund in fruit; bracts linear to linear-lanceolate, usually shorter than fruit. Fruiting pedicel 3–10 mm, erect or recurved. Calyx lobes spreading, linear, 2–3 mm, to 4 mm in fruit, apex acute. Corolla light blue, ca. 4 mm; tube ca. as long as calyx; throat appendages trapeziform, dark blue, ca. 0.8 mm; limb 5–6 mm wide; lobes divaricate, obovate. Style surpassing nutlets by ca. 1 mm, not surpassing prickles. Fruit ovoid-globose, 3–4 mm; nutlets ovoid, adaxially finely tuberculate; disc narrowly ovate, tuberculate, center line with unequal glochids; marginal glochids in 2 rows; inner glochids 1.5–2.5 mm, bases slightly widened but free; outer glochids on lateral surface below, 0.4–0.6 mm. Fl. and fr. Jul-Aug.

Hillside meadows; 1800–2500 m. Xinjiang [Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan].

1a. Herbs large, perennial; main root conical; stems many, unequal ..... 22c. var. *altaica*

- 1b. Herbs small, biennial; main root not conical; stems single.  
 2a. Fruiting pedicel often recurved, 3–5 mm ..... 22a. var. *tianschanica*  
 2b. Fruiting pedicel erect, 5–10 mm ..... 22b. var. *gracilis*

**22a. *Lappula tianschanica* var. *tianschanica***

天山鹤虱 (原变种) *tian shan he shi* (*yuan bian zhong*)

Herbs biennial, small. Main root not conical. Stems usually single, branched above middle; branches spreading. Basal leaves forming a rosette. Fruiting pedicel recurved, 3–5 mm.

Hillside meadows; ca. 1800 m. Xinjiang (Yuli Xian) [Kazakhstan, Kyrgyzstan, Russia, Tajikistan, Turkmenistan, Uzbekistan].

**22b. *Lappula tianschanica* var. *gracilis* C. J. Wang, Bull. Bot. Res., Harbin 1(4): 86. 1981.**

细枝天山鹤虱 *xi zhi tian shan he shi*

Herbs biennial, small. Main root not conical. Stems usually solitary; branches slender, becoming reclinate, 10–15 cm. Basal leaves not forming a rosette. Fruiting pedicel erect, 5–10 mm.

- Hillside meadows; ca. 2500 m. N Xinjiang (Qinghe Xian).

**22c. *Lappula tianschanica* var. *altaica* C. J. Wang, Bull. Bot. Res., Harbin 1(4): 86. 1981.**

阿尔泰鹤虱 *a er tai he shi*

Herbs perennial, large. Main root conical. Stems many, unequal in size; branches spreading. Basal leaves forming a rosette. Fruiting pedicel often recurved, 3–5 mm.

- Hillside meadows; ca. 2500 m. N Xinjiang (Qinghe Xian).

**23. *Lappula tadshikorum* Popov, Bot. Mater. Gerb. Bot. Inst. Komarova Akad. Nauk SSSR 14: 319. 1951.**

短梗鹤虱 *duan geng he shi*

Herbs biennial. Stems erect, much branched from base, ca. 45 cm tall, densely gray-white spreading or appressed hispid; branches slender, obliquely spreading. Basal leaves numerous, forming a rosette, sessile; leaf blade linear to lanceolate, 2–3 cm × ca. 5 mm, densely gray-white hirsute, apex obtuse. Inflorescences to 7–15 cm in fruit; bracts 1 or 2, leaflike, basal, other bracts extremely small. Pedicel erect, to 1–2(–3) mm in fruit, densely hispid. Calyx lobes spreading, linear, ca. 1 mm, to 2 mm in fruit. Corolla light blue, campanulate, ca. 2.5 mm; tube ca. as long as calyx; throat appendages light yellow, trapeziform, ca. 0.5 mm; limb (3–)4–5 mm wide; lobes suborbicular. Style slightly surpassing nutlets but not surpassing prickles. Fruit globose, 2.5–3 mm; nutlets ovoid, adaxially with dense fine tubercles; disc narrowly ovate, tuberculate, center line keeled and with 3 or 4 glochids; marginal glochids in 2 rows; inner glochids 1.5–2.5 mm, bases slightly widened but free; outer glochids ca. 0.5 mm.  $2n = 22$ .

Mountainsides; ca. 1800 m. Xinjiang (Wuqia Xian) [Kazakhstan, Kyrgyzstan, Russia, Tajikistan, Turkmenistan, Uzbekistan].

**24. *Lappula pratensis* C. J. Wang, Bull. Bot. Res., Harbin 1(4): 87. 1981.**

草地鹤虱 *cao di he shi*

Herbs biennial. Main root dark brown, straight, stout. Stems usually single, branched above, 10–35 cm tall, gray-white hispid; branches erect. Basal leaves numerous, forming a rosette, surrounded by persistent withered leaves; leaf blade spatulate to oblanceolate, 3–7 cm × 5–10 mm, gray-white hispid, abaxially with more numerous longer hairs, base attenuate, apex obtuse; midvein distinctly protruding; stem leaves widely spaced, linear. Inflorescences terminal on branches, elongated to 20 cm in fruit, with 1 or 2 leaflike bracts at base, other bracts small, slightly longer or shorter than pedicel. Pedicel 2–3 mm, or shorter above. Calyx lobes linear, ca. 1.5 mm, to 3 mm in fruit. Corolla light blue, ca. 4.5 mm; tube longer than calyx; throat appendages trapeziform, ca. 0.8 mm; limb 4–5 mm wide; lobes divaricate, oblong, ca. 2.5 mm. Style slightly surpassing nutlets by ca. 1 mm. Fruit broadly ovoid, ca. 3 mm; nutlets ovoid to narrowly ovoid, 2.5–3 mm, adaxially with dense fine tubercles; disc triangular-ovate to narrowly ovate, sparsely granulate, center line keeled and with several short glochids; marginal glochids in 2 rows; inner glochids 1–2 mm, bases slightly widened and contiguous; outer glochids 0.3–0.7 mm. Fl. and fr. Jul–Aug.

- Sunny hillside meadows in coniferous forest zone, meadows in valleys; 2300–2800 m. Xinjiang.

**25. *Lappula ramulosa* C. J. Wang & X. D. Wang, Acta Phytotax. Sin. 30: 367. 1992.**

多枝鹤虱 *duo zhi he shi*

Plants annual or biennial, densely appressed strigose. Stems numerous, cespitose, branched at base, ca. 35 cm tall; branches ascending. Basal leaves withered at fruiting time; stem leaves sessile, linear, 0.7–1.5 cm × 1–3 mm, ± appressed strigose, adaxially sparsely pubescent, apex obtuse. Inflorescences terminal on branches, densely branched; bracts narrowly ovate, lower bracts longer to slightly shorter than pedicel, upper bracts much shorter. Pedicel 4–7 mm, appressed strigose. Calyx ca. 2 mm at anthesis, to 3.5 mm in fruit; lobes erect or appressed to nutlets. Corolla funnellform, blue, ca. 4 mm; tube ca. 2 mm; throat appendages trapeziform; limb 4–5(–7) mm wide; lobes oblong. Gynobase 1.5–2 mm, longer than nutlets. Nutlets triangular-ovoid, tuberculate, inner angle united with gynobase for 2/3 length; disc center line keeled with a few glochids; marginal glochids in 2 rows; inner glochids 0.3–0.6 mm; outer glochids 0.1–0.2 mm. Fl. and fr. Aug.

- Mountain meadows. Xinjiang.

**26. *Lappula consanguinea* (Fischer & C. A. Meyer) Gürke in Engler & Prantl, Nat. Pflanzenfam. 4(3a): 107. 1897.**

蓝刺鹤虱 *lan ci he shi*

Herbs annual or biennial, over 60 cm tall. Stems usually single, rarely 2- or 3-fascicled, branched above, strigose

or spreading hispid. Basal leaves oblong-lanceolate, to 5 cm, densely white hirsute, withered in fruit; stem leaves lanceolate to linear, 2–5 cm × 3–6 mm, flat or longitudinally folded along midvein, densely hirsute, hairs discoid at base, base attenuate, apex obtuse; midvein distinctly protruding. Inflorescences terminal on stems and branches, 7–25 cm in fruit; bracts linear. Fruiting pedicel erect, 1–3 mm, strigose. Calyx lobes spreading, linear, 2.5–3 mm, to 4–5 mm in fruit. Corolla light blue-purple, campanulate, 3.5–4 mm; throat appendages ca. 0.5 mm; limb 2.5–3 mm wide; lobes oblong to broadly obovate. Style surpassing nutlets by ca. 1 mm. Fruit broadly ovoid, 2.5–3 × ca. 3 mm, above with spaces between nutlets; nutlets acute ovoid, adaxially with scattered tubercles; disc narrowly ovate, granulose; marginal glochids in 3 rows; inner glochids ca. 1.5 mm, thin, hard, ascending to erect, bases somewhat widened and free; middle glochids shorter, somewhat clavate; outer glochids extremely short, adaxial in lower part.

Waste areas, rocky slopes, mountain terraces, roadsides; 600–2200 m. Gansu, Hebei, Nei Mongol, Ningxia, Qinghai, Xinjiang [N India, Kashmir, Kazakhstan, Kyrgyzstan, Mongolia, Pakistan, Russia, Tajikistan, Turkmenistan, Uzbekistan; Europe].

- 1a. Nutlets homomorphic throughout ..... 26a. var. *consanguinea*  
1b. Nutlets heteromorphic in upper part of inflorescences ..... 26b. var. *cupuliformis*

### 26a. *Lappula consanguinea* var. *consanguinea*

蓝刺鹤虱 (原变种) lan ci he shi (yuan bian zhong)

*Echinosperrum consanguineum* Fischer & C. A. Meyer, Ind. Sem. Hort. Petrop. 5: 35. 1838.

Nutlets homomorphic throughout. Fl. Jun-Jul, fr. Jul-Sep.

Waste areas, rocky slopes, mountain terraces; 800–2200 m. Gansu, Hebei, Nei Mongol, Ningxia, Qinghai, Xinjiang [N India, Kashmir, Kazakhstan, Kyrgyzstan, Mongolia, Pakistan, Russia, Tajikistan, Turkmenistan, Uzbekistan; Europe].

### 26b. *Lappula consanguinea* var. *cupuliformis* C. J. Wang, Bull. Bot. Res., Harbin 1(4): 88. 1981.

杯翅蓝刺鹤虱 bei chi lan ci he shi

Heteromorphic nutlets on upper part of inflorescences, 2 nutlets with inner marginal glochids of disc distinctly widened at base and confluent into a broad wing; wing usually erect, ± cupular. Fl. and fr. Jul-Sep.

• Dry mountain terraces, roadsides; ca. 600 m. Xinjiang.

27. *Lappula ferganensis* (Popov) Kamelin & G. L. Chu in G. L. Chu, Kamelin, R. R. Mill, & M. G. Gilbert, Novon 5: 17. 1995.

费尔干鹤虱 fei er gan he shi

*Lepechiniella ferganensis* Popov in Komarov, Fl. URSS 19: 713. 1953; *Lappula platyptera* C. J. Wang.

Herbs biennial; rhizomes ± horizontal, producing stems from nodes. Stems not branched or few branched, ca. 30 cm

tall, sparsely gray fine pilose. Basal leaves fascicled, forming a rosette, sessile; leaf blade linear to linear-oblongate, 1.5–4.5 cm × 2–4 mm, abaxially densely sericeous, becoming silvery, adaxially gray-green, sparsely sericeous, base attenuate, apex obtuse; stem leaves sparse, sessile, linear to narrowly ovate, 0.5–2 cm × 1.5–2 mm, sparsely sericeous. Inflorescences terminal, few flowered, elongated in fruit; bracts narrowly ovate to linear, ca. as long as nutlets. Fruiting pedicel erect, 2–4 mm, slightly thickened. Calyx lobes linear-oblong, ca. 2 mm, to 3 mm in fruit, sericeous, apex obtuse. Corolla light blue, ca. 3 mm; tube ca. as long as calyx; throat appendages trapeziform, ca. 0.5 mm; limb ca. 3 mm wide; lobes oblong, 1–1.2 mm. Style included between nutlets. Fruit depressed globose, 4–4.5 × 6–7 mm; nutlets 3.5–4 × ca. 7 mm, wrinkled, granulose, disc ovate, marginal glochids in 2 rows; inner glochids unequal, 0.5–1.5 mm, confluent into a broad wing; wing subleathery, 1.5–2 mm wide, usually spreading horizontally; outer glochids 0.2–0.8 mm. Fl. and fr. Jun-Sep.

• Mountainsides; ca. 3300 m. SW Xinjiang (Wuqia Xian).

### 28. *Lappula anocarpa* C. J. Wang, Bull. Bot. Res., Harbin 1(4): 93. 1981.

畸形果鹤虱 ji xing guo he shi

Herbs annual. Roots single, conical, straight, stout. Stems much branched above, 35–48 cm tall, somewhat spreading or appressed hispid; branches ascending. Basal leaves few, withered in fruit; leaf blade spatulate, to 7 cm × 5–7 mm, base attenuate, apex obtuse; stem leaves sessile, lanceolate, 3–5 cm × 4–6 mm, spreading or appressed hirsute, adaxially with fewer hairs, base attenuate, apex acute. Inflorescences terminal on branches, elongated to 20 cm in fruit; bracts linear-lanceolate, much longer than fruit. Flowers widely spaced. Pedicel 2.5–3.5 mm in fruit. Calyx lobes spreading, linear, 3–3.5 mm, to 5–6 mm in fruit, hirsute. Corolla light blue, ca. 4 mm; tube slightly shorter than calyx; throat appendages trapeziform, ca. 0.8 mm; limb 2.5–3 mm wide; lobes erect-spreading, oblong. Style surpassing nutlets by 0.5 mm, not surpassing prickles. Fruit broadly ovoid, homomorphic along lower part of inflorescences; nutlets narrowly ovoid, densely tuberculate, disc with 2 rows of glochids along margin; inner glochids 1.5–2 mm, base somewhat widened but free; outer glochids ca. 0.5 mm, usually at base of vertical surface. Fruit of upper part of inflorescences heteromorphic, 2 nutlets with a broad wing; inner glochids of disc margin 1–2 mm, bases strongly widened and confluent into a wing 0.6–1 mm; outer glochids ca. 0.5 mm, on base of nutlets, other 2 nutlets wingless. Fl. and fr. Jul-Sep.

• Fields, waste areas, slopes on loess plateau. C and NE Gansu.

### 29. *Lappula heteromorpha* C. J. Wang, Bull. Bot. Res., Harbin 1(4): 95. 1981.

异形鹤虱 yi xing he shi

Herbs annual. Stems much branched above, to 65 cm tall; branches ascending, spreading hispid. Lower stem leaves withered in fruit; leaf blade narrowly spatulate to linear-lanceolate, 4–6 cm × 3–5 mm, strigose, adaxially less so, base attenuate, apex obtuse; upper stem leaves narrower, shorter. Inflorescences terminal on branches, to 20 cm in fruit,

becoming widely spaced; with leaflike bracts on lower part of inflorescences, longer than fruit; upper bracts linear, slightly longer than fruit. Calyx lobes spreading or revolute, linear, ca. 4 mm, to 6 mm in fruit, hispid, apex acute. Corolla blue-purple, ca. 4.5 mm; tube ca. 3 mm; throat appendages trapeziform, ca. 0.6 mm; limb ca. 4 mm wide; lobes spreading horizontally, oblong, 1–1.5 mm. Style slightly surpassing nutlets. Fruit broadly ovoid, 4–4.5 in diam., nutlets homomorphic along lower part of inflorescences, wingless, narrowly ovoid, 4–4.5 mm, densely granulose; disc with short glochids on keel along center line, with 2 rows of glochids along margin; inner glochids 1–2.5 mm, bases somewhat widened but free, outer glochids 1–1.2 mm. Nutlets heteromorphic in upper part of inflorescences, 2 with inner glochids on disc margin 1.5–2 mm, bases strongly widened and confluent into a divaricate wing; outer glochids 1–1.8 mm; 2 other nutlets with homomorphic prickles. Fl. and fr. Jul-Sep.

• Fields, waste places, near villages. Nei Mongol (Otog Qi Xian), Shanxi (Wutai Xian).

**30. *Lappula alata* (Popov) Goloskokov, Fl. Rast. Res. Kaz. 78. 1975.**

阿尔套鹤虱 a er tao he shi

*Lappula rupestris* (Schrenk) Gürke var. *alata* Popov in Komarov, Fl. URSS 19: 457. 1953; *L. scleroptera* C. J. Wang.

Herbs biennial. Main root conical, stout. Stems 5 or 6, diffuse, slightly branched above, 10–14 cm tall, gray strigose. Basal leaves forming a rosette; leaf blade linear-spatulate, rarely linear-lanceolate, 1–3 cm × 2–4 mm, strigose, abaxially more densely pubescent, base attenuate, margin ciliate, apex obtuse; stem leaves smaller, oblong, 5–10 × 2–3 mm. Inflorescences to 12 cm in fruit; bracts leaflike on lower part of inflorescences, oblong, ca. 5 mm; upper bracts linear, ca. 0.3 mm. Fruiting pedicel 1.5–2.5 mm. Calyx lobes linear, 2–2.5 mm, to 3–4 mm in fruit, apex obtuse. Corolla light blue, 4–5 mm; tube ca. as long as calyx; throat appendages trapeziform, ca. 0.8 mm; limb 5–6 mm wide; lobes divaricate, obovate. Nutlets 2.5–3 mm, heteromorphic, granulose; 2 nutlets with a single row of glochids along disc margin; glochids leathery, 1–1.5 mm, bases widened and confluent into a narrow wing, sometimes with several short glochids along center line; remaining 2 nutlets wingless, with few glochids or glabrous along disc. Gynobase surpassing nutlets by ca. 0.8 mm. Fl. and fr. Jul-Aug.

Arid alluvial mountain terraces; ca. 2500 m. Xinjiang (Hejing Xian) [Kazakhstan, Russia, Tajikistan, Turkmenistan, Uzbekistan].

**31. *Lappula monocarpa* C. J. Wang, Bull. Bot. Res., Harbin 1(4): 98. 1981.**

单果鹤虱 dan guo he shi

Herbs annual. Stems stout, branched above, spreading and appressed hirsute; stem leaves linear, 1.5–3.5 cm × 2–3 mm, flat or longitudinally flexed along midvein, spreading white hirsute, hairs discoid at base. Inflorescences terminal on branches, elongated in fruit; bracts leaflike, much longer than fruit. Calyx lobes linear, 2–2.5 mm, slightly enlarged.

Corolla light blue, ca. 3 mm; tube somewhat shorter than calyx; throat appendages ca. 0.5 mm; limb ca. 2 mm wide; lobes divaricate, suboblong. Ovary globose, 4-parted, with 1 mericarp developing into a nutlet. Gynobase ca. as long as nutlet, usually horizontal but somewhat raised at apex. Developed nutlet 1, acute ovoid, ca. 2 mm, usually horizontal, granulose, adaxial base coherent to gynobase, disc margin with a single row of glochids; glochids 0.5–1 mm. Fl. and fr. Jul-Aug.

• Sunny hillside meadows; ca. 1100 m. NW Xinjiang (Jeminay Xian).

**32. *Lappula lasiocarpa* (W. T. Wang) Kamelin & G. L. Chu in G. L. Chu, Kamelin, R. R. Mill, & M. G. Gilbert, Novon 5: 18. 1995.**

翅鹤虱 chi he shi

*Lepechiniella lasiocarpa* W. T. Wang, Bull. Bot. Res., Harbin 4: 7. 1984; *Lappula betpakdalensis* Nabiev; *L. omphaloides* (Schrenk) Popov var. *balchaschensis* Popov; *Lepechiniella balchaschensis* Popov, not *Lappula balchaschensis* Popov ex N. Pavlov.

Herbs annual. Stems frequently branched from base, 6–20 cm tall, spreading hispid. Basal leaves few, usually withering early, narrowly obovate, 1–2 cm; stem leaves sessile or lower leaves attenuate at base to thin petiole, spatulate-linear, 0.8–2.5 cm, white hispid, apex acute or obtuse. Inflorescences to 8 cm; bracts linear to linear-lanceolate, 2–5 mm. Flowers short pedicellate, widely spaced. Calyx ca. 2.3 mm; lobes linear, densely minutely hispid. Corolla light blue, ca. 4 mm; tube shorter than calyx, ca. 1.2 mm; throat appendages trapeziform, ca. 0.7 mm, apex obtuse; limb 5-parted; lobes obovate, ca. 2 mm. Stamens inserted above middle of corolla tube; anthers oblong, ca. 0.5 mm. Style short terete, ca. 0.6 mm; stigma discoid. Nutlets brown, narrowly ovoid, ca. 3 mm, tuberculate; disc wing constricted upward, becoming yellowish, saccate, densely pubescent, margin entire. Fl. and fr. May-Jun.

Dunes. N Xinjiang [Kazakhstan].

**33. *Lappula transalaica* (B. Fedtschenko ex Popov) Nabiev, Consp. Fl. As. Med. 8: 198. 1986.**

隐柱鹤虱 yin zhu he shi

*Lepechiniella transalaica* B. Fedtschenko ex Popov in Komarov, Fl. URSS 19: 714. 1953.

Herbs perennial; caudex few branched, forming small tufts of leaf rosettes. Stems several to many, laterally ascending, 10–25 cm tall. Basal leaves in rosettes, elongated linear or spatulate-linear, 4–6(–10) cm × 2–5 mm, gray sericeous; stem leaves linear, 1–3 cm × 1–3 mm, apex obtuse. Inflorescences leafless, loose, to 5–6 cm in fruit. Pedicel short, smaller, to 3–5 mm in fruit. Calyx ca. 2 mm. Corolla light blue or white; limb flat, 5–8 mm wide; lobes rounded-ovate; appendages trapeziform-ovate, ca. 1 mm. Nutlets with wings wider than long, rounded-ovoid, 5–7 mm wide; disc finely tuberculate, keeled, winged; wing yellowish, wide, leathery, undulate-plicate, generally flat, margin turning blue, with 3–5 glochids on each side, densely papilliform-aculeate

adaxially. Gynophore and very short style hidden. Fl. Jun-Jul, fr. Aug.

Stony places in mountains. W Xinjiang (Transalai Range west of Ulugat and Pamir) [Kyrgyzstan, Tajikistan].

**34. *Lappula lipskyi*** Popov, Bot. Mater. Gerb. Bot. Inst. Acad. Nauk SSSR 14: 311. 1951.

短柱鹤虱 *duan zhu he shi*

Herbs annual. Stems 20–35 cm, branched from base or above. Leaves oblong-spatulate, 1–3(–4) cm × 5–10 mm, abaxially somewhat grayish with large white tubercles and spreading pubescent or bristly, adaxially green and subglabrous. Inflorescences loose. Pedicel erect, 1–2 mm. Calyx ca. 2 mm; lobes oblong-linear, white tuberculate and strigose, apex obtuse. Corolla sky blue; limb flat, (5–)5.5–6 mm; lobes ovate-rounded. Nutlets heteromorphic, 3.5–4 mm, with or without a leathery dentate wing, with 5–7 upright triangular teeth on each side along wing margin or with short glochids along disc margin; disc with protruding keel. Style short, hidden. Fl. Jun-Jul, fr. Jul-Aug.

Slopes of hills, mainly acidic soils. NW Xinjiang (Altay Shan) [Kazakhstan, W Mongolia].

**35. *Lappula macrantha*** (Ledebour) Gürke in Engler & Prantl, Nat. Pflanzenfam. 4(3a): 107. 1897.

大花鹤虱 *da hua he shi*

*Echinosperrum macranthum* Ledebour, Fl. Altaic. 1: 205. 1829.

Herbs annual. Stems 20–40 cm, usually branched from base; branches ascending, sparsely spreading pubescent. Leaves light green, lanceolate-spatulate or oblong, wide and flat, 2–4 cm × 5–10 mm, abaxially densely spreading pubescent, apex obtuse. Inflorescences branches 3–8 cm, not very loose; bracts small lanceolate. Pedicel 1–2 cm, pubescent. Calyx 1.5–2 mm, elongated in fruit; lobes lanceolate. Corolla sky blue; limb slightly funnellform, 5–8 mm wide; lobes ovate-rounded. Nutlets 4–5 mm; disc with keel of small anchorlike spines and tuberculate, margin with flat whitish yellow glochids 2–3 mm; glochids 4–6 on each side of disc. Style completely hidden. Fl. Apr-Jun, fr. May-Jul.

Sandy and acidic soils of mountain slopes. NW Xinjiang (Ertix He River, Altay Shan) [Kazakhstan, Mongolia].

It is doubtful that this species belongs in *Lappula*. The short style hidden by the nutlets and the comparatively short attachment scar of the nutlets are more characteristic of *Lepechiniella*.

**36. *Lappula physacantha*** Goloskokov, Bot. Mater. Gerb. Inst. Bot. Akad. Nauk. Kazahsk. SSR 10: 34. 1977.

囊刺鹤虱 *nang ci he shi*

Herbs annual. Stems (10–)20–40 cm, branched from base, pubescent, glaucous green. Basal leaves early deciduous; stem leaves oblong or lanceolate, 2–4 cm × 3–8 mm, reflexed, acute, with tubercle-based setae. Inflorescences leafy, to (5–)10–20(–30) cm. Corolla blue; limb to ca. 3.5 mm. Nutlets 4, homomorphic; gynophore hidden between nutlets; disc margin wingless, not involute; marginal glochids 2–2.5 mm, terete, hollow, in 1 row.

Stony deserts. Xinjiang (Tien Shan) [Kyrgyzstan].

## 34. HETEROCARYUM A. de Candolle, Prodr. 10: 144. 1846.

异果鹤虱属 *yi guo he shi shu*

Herbs annual, hirsute, hairs tuberclelike at base. Stems erect or decumbent, branched. Cymes bracteate. Calyx 5-parted to base; lobes enlarged in fruit. Corolla funnellform to campanulate; throat appendages 5, trapeziform. Stamens included. Ovary 4-parted. Style short; stigma capitate. Gynobase columnar, low. Nutlets homomorphic or heteromorphic, dorsiventrally compressed, firmly coherent to gynobase along entire adaxial surface; abaxially discoid, with prickles or other appendages.

About seven species: C to SW Asia; one species in China.

**1. *Heterocaryum rigidum*** A. de Candolle, Prodr. 10: 145. 1846.

异果鹤虱 *yi guo he shi*

*Echinosperrum heterocaryum* Bunge; *E. szovitsianum* Boissier.

Stems usually single, erect, 10–25 cm tall. Leaves gray-green, linear, 1–3 cm × 1–2 mm. Pedicel to 1.2 cm in fruit; bracts linear. Flowers pedicellate. Calyx lobes linear, ca. 2.5 mm, slightly enlarged in fruit, pubescent. Corolla blue-purple,

somewhat longer than calyx; tube ca. as long as limb, with 5 longitudinal keels outside; throat distinctly constricted, appendages ca. 0.4 mm; lobes of limb ovate-lanceolate, apex obtuse. Stamens inserted at middle of corolla tube; anthers ovate, ca. 0.4 mm. Style ca. 0.6 mm. Nutlets narrowly ovate, 5–6 mm; disc with 1 row of glochids along margin, tuberculate at middle. Fl. and fr. Apr-Jun.

Deserts. C and W Xinjiang [Afghanistan, Kazakhstan, Kyrgyzstan, Pakistan, Russia, Tajikistan, Turkmenistan, Uzbekistan; SW Asia].

## 35. CRANIOSPERMUM Lehmann, Pl. Asperif. Nucif. 336. 1818.

颅果草属 *lu guo cao shu*

Herbs perennial or biennial. Leaves alternate. Cymes bracteate or ebracteate on lower part. Flowers sessile or short pedicellate. Calyx 5-parted; lobes erect, lanceolate-linear, somewhat enlarged in fruit, subtending fruit, hirsute. Corolla long tubular, slightly thickened distally; throat without appendages, sometimes with scalelike emergences alternate with corolla lobes; limb 5-parted; lobes vertical or spreading, triangular to ovate. Stamens inserted at middle of corolla tube, with exerted long filaments and linear-oblong anthers. Ovary 4-parted. Style exerted from corolla, entire at apex; stigma capitate or dotlike. Gynobase narrowly fastigiata. Nutlets oblong, glabrous, with cupular emergence abaxially; margin of emergence narrowly winged, entire or dentate; attachment scar at base adaxially. Seeds ovoid, dorsiventrally compressed.

Four or five species: C Asia; two species in China.

- 1a. Herbs perennial, monocarpic; stems branched above; corolla dark blue-violet; filaments and anthers long exerted ..... 1. *C. mongolicum*  
 1b. Herbs polycarpic; stems not branched; corolla rose-lilac; filaments not exerted, anthers slightly exerted ..... 2. *C. subfloccosum*

**1. *Craniospermum mongolicum*** I. M. Johnston, J. Arnold  
 Arbor. 33: 74. 1952.

颅果草 luo guo cao

Herbs perennial. Stems usually 1–3, erect, branched above, to 20 cm tall, hirsute and short appressed pubescent. Leaves sessile, spatulate-linear to narrowly oblanceolate, 2–6 cm × 6–10 mm, short appressed pubescent, less so abaxially, apex obtuse to subobtuse. Cymes centered on upper part of stems; bracts subulate, ca. as long as calyx. Flowers short pedicellate, crowded. Calyx lobes linear, ca. 5 mm, to 1 cm in fruit, hirsute, short appressed pubescent. Corolla blue, ca. 1 cm; throat unappendaged; limb spreading, ovate to oblong, ca. 3 mm. Stamens inserted above middle; filaments ca. 7 mm, much exerted, scalelike inward, inflated at attachment point of filament base; anthers ca. 2 mm. Style included or slightly exerted; stigma obscure. Nutlets ca. 4.5 × 2.5 mm, abaxial cupular emergence ca. 4.5 mm, marginal wing finely dentate; attachment scar below middle abaxially. Seeds ca. 3 mm. Fl. Jun.

Arid canyons; ca. 1700 m. Nei Mongol, N Xinjiang [Mongolia, Russia].

**2. *Craniospermum subfloccosum*** Krylov, Trudy Imp. S.-Peterburgsk. Bot. Sada 21: 10. 1903.

卷毛颅果草 juan mao luo guo cao

Herbs perennial; caudex subterrestrial, bearing rosettes and 1 to few stems, 7–15 cm tall. Basal leaves grayish, lanceolate, 5–9 cm × 4–6 mm, apex acute, gradually tapering to petiole; stem leaves sessile, wide lanceolate, smaller than basal leaves, upper part with stems densely covered by flocculent tomentum of fine long hairs, apex obtuse. Inflorescences subcapitate, many flowered, subtended by 1 or 2 stem leaves; bracts lanceolate-linear, small. Calyx 6.5–7.5 mm, densely pubescent. Corolla rose-lilac, 9–10 mm; lobes triangular-lanceolate, apex obtuse. Anthers exerted. Nutlets unknown. Fl. (?May) Jul-Aug.

On rocks. NW Xinjiang [Kazakhstan (Altai Mts.), W Mongolia, Russia (Altai Mts.)].

### 36. TRICHODESMA R. Brown, Prodr. 496. 1810.

毛束草属 mao shu cao shu

*Lacaitaea* Brand.

Subshrubs or perennial herbs, minutely hispid or glabrous. Leaves opposite or alternate, entire. Cymes terminal, becoming racemelike or paniculate, bracteate. Calyx 5-parted, becoming fastigiata or ovoid, base 5-veined or winged; lobes oblong to lanceolate, enlarged in fruit. Corolla broadly tubular, frequently tomentose inside; throat appendages usually absent; limb 5-parted; lobes triangular-ovate, apex caudate-attenuate. Stamens inserted on lower part of corolla tube; anthers oblong-linear to lanceolate, with awnlike and spiral-twisted connectives at apex. Ovary 4-parted. Style linear, exerted from corolla throat; stigma obscure. Gynobase fastigiata and 4-veined longitudinally. Nutlets dorsiventrally compressed, margin of abaxial surface protruding, becoming cupular, dentate. Seeds suborbicular.

About 40 species: Africa, tropical Asia, Australia; one species in China.

The genus *Lacaitaea* was created by Brand for *Trichodesma calycosum*, the only species of *Trichodesma* with appendages in the throat. The unusual number of 10 appendages is due to the partition of each scale by a vein running down from the corolla lobe. It is difficult to understand why this species alone possesses a peculiarity of usually considerable taxonomic importance, as already pointed out by Johnston (J. Arnold Arbor. 33: 75. 1952). The species is retained in *Trichodesma* because it is very similar to other species of *Trichodesma* in all other characters.

**1. *Trichodesma calycosum*** Collett & Hemsley, J. Linn. Soc.,  
 Bot. 28: 92. 1890.

毛束草 mao shu cao

Subshrubs, 1–2.5 m tall. Branches becoming somewhat trigonous, glabrous. Leaves opposite, elliptic to broadly elliptic, 1–2.8 cm × 4–8 cm, strigose, abaxially more densely strigose, base attenuate to short petiole, margin entire. Cymes terminal, paniculate, to 20 cm, densely rust-colored short hispid. Pedicel slender, usually irregularly curved; bracts ovate-lanceolate to lanceolate, 2–4 × 0.5–1.5 cm, ± sessile. Calyx campanulate, ca. 1.5 cm, enlarged and inflated in fruit to 4 cm wide, strigose outside; lobes ovate-triangular, apex caudate-attenuate. Corolla white or pinkish, slightly longer than calyx, densely tomentose below inside; throat 10-appendaged; lobes ovate. Anthers lanceolate, connectives exerted from corolla. Ovary 1–3-lobed, other lobes aborted. Nutlets broadly ovoid, ca. 5 × 4 mm, margin of abaxial surface leathery, irregularly obtuse-dentate. Seeds orbicular, complanate. Fl. Jan–Mar.

Hillside meadows, thickets, forests; 500–2200 m. Guizhou, Taiwan, Yunnan [India, Laos, Myanmar, Thailand].

- 1a. Only abaxial surface of anthers pubescent, hairs not in 2 lines ..... 1a. var. *calycosum*  
 1b. All surfaces of anthers pubescent, spreading into 2 lines on each surface ..... 1b. var. *formosanum*

### 37. LASIOCARYUM I. M. Johnston, Contr. Gray Herb. 75: 45. 1925.

毛果草属 mao guo cao shu

*Oreogenia* I. M. Johnston.

Herbs annual or biennial, pilose. Leaves entire. Cymes ebracteate. Calyx 5-parted to base, slightly enlarged. Corolla tubular; tube ca. as long as calyx; throat appendages 5; limb 5-parted; lobes overlapping, orbicular to obovate, apex obtuse. Stamens inserted at middle of corolla, included; anthers ovoid, ± obtuse. Ovary 4-parted. Style included; stigma capitate. Gynobase subulate. Nutlets narrowly ovoid, short hispid, transversely wrinkled strigose, adaxially coherent with gynobase; attachment scar narrow, long, at middle and below adaxially.

Four or five species: Bhutan, China, India, Pakistan; SW Asia; three species in China.

- 1a. Calyx lobes broadly lanceolate to oblong-ovate; lobes of corolla limb ca. 0.5 mm wide; fruiting pedicel to 1.5 cm ..... 1. *L. munroi*  
 1b. Calyx lobes linear-lanceolate; lobes of corolla limb ca. 1 mm wide or greater; fruiting pedicel not more than 1 cm.  
 2a. Corolla limb ca. 4 mm wide; nutlets ca. 1.4 mm; basal leaves ± sessile; pedicels in lower part of inflorescences to 8 mm ..... 2. *L. trichocarpum*  
 2b. Corolla limb ca. 3 mm wide; nutlets ca. 1.2 mm; basal leaves distinctly petiolate; pedicels in lower part of inflorescences ca. 1 mm ..... 3. *L. densiflorum*

**1. *Lasiocaryum munroi*** (C. B. Clarke) I. M. Johnston, Contr. Gray Herb. 75: 46. 1925.

小花毛果草 xiao hua mao guo cao

*Eritrichium munroi* C. B. Clarke in J. D. Hooker, Fl. Brit. India 4: 165. 1883; *Oreogenia munroi* (C. B. Clarke) I. M. Johnston.

Herbs annual, 5–10 cm tall. Stems usually several, erect, slender, pilose. Leaves sessile, basal ones with attenuate base; leaf blade narrowly ovate to spatulate, 3–10 × 1.5–3.5 mm, sparsely pubescent, margin entire; veins obscure.

#### 1a. *Trichodesma calycosum* var. *calycosum*

毛束草 (原变种) mao shu cao (yuan bian zhong)

*Lacaitaea calycosa* (Collett & Hemsley) Brand; *Trichodesma calcareum* Craib; *T. hemsleyanum* H. Léveillé; *T. sinicum* Brand.

Only abaxial surface of anthers pubescent, hairs not in 2 lines.

Hillside meadows, thickets, forests; 500–2200 m. SW Guizhou, S Yunnan [NE India, Laos, Myanmar, N Thailand].

#### 1b. *Trichodesma calycosum* var. *formosanum* (Matsumura) I. M. Johnston, J. Arnold Arbor. 33: 78. 1952.

台湾毛束草 tai wan mao shu cao

*Trichodesma formosana* Matsumura, Bot. Mag. (Tokyo) 12: 108. 1898.

All surfaces of anthers pubescent, hairs spreading into 2 lines on each surface.

- Taiwan.

Inflorescences ± racemose, ebracteate. Pedicel suberect, to 1.5 cm in fruit. Flowers widely spaced. Calyx lobes erect, broadly lanceolate to oblong-ovate, ca. 2 mm, somewhat enlarged in fruit, sparsely pubescent. Corolla light blue, tubular, ca. 2.5 mm; throat appendaged; lobes suborbicular, ca. 0.5 mm wide. Nutlets oblong-ovoid, ca. 1 × 0.5 mm, wrinkled, short appressed pubescent; attachment scar narrowly ovate.

3400–4000 m. S Xizang (Cona Xian) [Bhutan, N India, Nepal].

**2. *Lasiocaryum trichocarpum*** (Handel-Mazzetti) I. M. Johnston, Contr. Gray Herb. 75: 46. 1925.

云南毛果草 yun nan mao guo cao

*Microcaryum trichocarpum* Handel-Mazzetti, Anz. Akad. Wiss. Wien. Math.-Nat. Kl. 61: 164. 1924; *Oreogenia trichocarpum* (Handel-Mazzetti) Brand.

Herbs annual, 3–9 cm tall. Stems single or several, erect or decumbent, usually branched above middle, pilose. Leaves ± sessile, obovate to ovate-oblong, 5–13 × 2–6 mm, villous, obscurely veined, base cuneate, apex obtuse; basal leaves attenuate. Inflorescences terminal, several flowered, gradually elongated to 2 cm, ebracteate. Pedicel in lower part of inflorescences to 8 mm. Flowers pedicellate. Calyx ca. 2.5 mm, villous outside; lobes linear. Corolla blue; tube ca. as long as calyx; throat appendages low trapeziform, slightly 2-cleft; limb ca. 4 mm wide; lobes spreading, suborbicular to broadly obovate. Anthers ovoid, ca. 0.5 mm. Style ca. 0.7 mm. Nutlets brown, narrowly ovoid, ca. 1.4 mm, densely short appressed pubescent on transverse wrinkles, somewhat keeled abaxially along center line; attachment scar narrowly ovate. Fl. Jun-Jul.

• Slopes; ca. 3000 m. SW Sichuan, W Yunnan.

3. *Lasiocaryum densiflorum* (Duthie) I. M. Johnston, J.

### 38. ASPERUGO Linnaeus, Sp. Pl. 1: 138. 1753.

糙草属 cao cao shu

Herbs annual, climbing, hispid. Leaves alternate. Pedicel short or absent. Flowers solitary or fascicled at leaf axils. Calyx 5-parted, 2-dentate between lobes, strongly enlarged in fruit, bilaterally compressed, becoming somewhat clamshell-shaped, with distinct reticulate venation, irregularly emarginate-serrate; lobes unequal. Corolla violet or white, tubular; throat appendaged; limb 5-parted. Stamens included; filaments extremely short; anthers short oblong. Ovary 4-parted. Style included; stigma capitate. Gynobase subulate. Nutlets nearly flat, bilaterally compressed, densely white tuberculate, apex obtuse; attachment scar near apex adaxially. Seeds vertical; cotyledons ovate, complanate.

One species: Asia, Europe.

1. *Asperugo procumbens* Linnaeus, Sp. Pl. 1: 138. 1753.

糙草 cao cao

Stem slender, to 90 cm tall, hollow, with 5 or 6 longitudinal ribs, glochidiate along ribs, usually branched. Lower stem leaves petiolate, spatulate or narrowly oblong, 5–8 × 0.8–1.5 cm, sparsely minutely hispid, margin entire or finely dentate; upper stem leaves sessile, becoming gradually smaller and subopposite. Pedicel short or absent. Calyx ca. 1.6 mm, parted to below middle, minutely hispid;

Arnold Arbor. 21: 51. 1940.

毛果草 mao guo cao

*Eritrichium densiflorum* Duthie, Bull. Misc. Inform. Kew 1912: 39. 1912.

Herbs annual, 3–6 cm tall. Stems usually strongly branched from base, appressed pubescent. Basal leaves petiolate; stem leaves sessile or nearly so, ovate to elliptic or narrowly obovate, 5–12 × 2–5 mm, pilose, base attenuate, apex obtuse or acute; veins obscure. Inflorescences terminal, many flowered, to 3 cm in fruit. Pedicel ca. 1 mm. Calyx ca. 2 mm, to 3 mm in fruit; lobes somewhat unequal, linear, base longitudinally keeled. Corolla blue, glabrous; tube ca. as long as calyx; throat yellow, with 5 appendages slightly 2-cleft; limb ca. 3 mm wide; lobes spreading, obovate, 1–1.3 mm, apex obtuse, sometimes retuse. Anthers ovoid, ca. 0.3 mm. Nutlets light brown, narrowly ovoid, ca. 1.2 mm, short appressed pubescent along wrinkles, abaxially slightly keeled along center line; attachment scar narrowly ovate. Seeds brown, ovoid, slightly dorsiventrally compressed. Fl. Aug.

Rocky slopes; 4000–4500 m. W Sichuan, S Xizang [Bhutan, N India, Nepal, Pakistan].

lobes somewhat unequal, linear-lanceolate, to 8 mm wide after anthesis. Corolla blue, ca. 2.5 mm; tube longer than limb; throat appendages tuberclelike; lobes of limb somewhat unequal, broadly ovate to ovate. Anther ca. 0.6 mm. Style ca. 0.8 mm, included. Nutlets narrowly ovoid, ca. 3 mm; attachment scar orbicular. Fl. and fr. Jul-Sep.  $2n = 48$ .

Hillside meadows, near villages, field margins; above 2000 m. Gansu, Nei Mongol, Qinghai, N Shaanxi, Shanxi, Sichuan, Xinjiang, NE Xizang [N India, Kashmir, Kazakhstan, Kyrgyzstan, Mongolia, Nepal, Russia, Tajikistan, Turkmenistan, Uzbekistan; N and NW Africa, SW and W Asia, Europe].

### 39. ROCHELIA Reichenbach, Flora 7: 243. 1824.

李果鹤虱属 luan guo he shi shu

Herbs annual. Stems branched or simple, slender, hispid. Leaves alternate, 1-veined. Cymes scorpioid; bracts ± opposite flowers. Flowers pedicellate. Calyx 5-parted to base; lobes linear to lanceolate, somewhat enlarged in fruit, apex usually incurved, rarely straight. Corolla funnelform, light blue; tube straight or slightly curved; throat appendaged; limb 5-parted. Stamens inserted at lower part of corolla tube, included; filaments short; anthers oblong, apex with somewhat prominent connectives. Ovary divided; ovules 2. Style entire; stigma capitate. Gynobase subulate. Nutlets 2, each containing 1 seed, tuberculate, with glochids or glabrous; attachment scar near base.

About 15 species: C and SW Asia, Australia, Europe; five species in China.

1a. Calyx lobes triangular, cordate basally ..... 5. *R. cardiosepala*

- 1b. Calyx lobes not triangular, not cordate basally.
- 2a. Calyx united above base ..... 4. *R. peduncularis*
- 2b. Calyx completely divided.
- 3a. Calyx lobes straight, with protruding midvein ..... 3. *R. rectipes*
- 3b. Calyx lobes arciform, curved around nutlets, midvein not protruding.
- 4a. Nutlets glabrous, lustrous ..... 2. *R. leiocarpa*
- 4b. Nutlets tuberculate, densely stellate ..... 1. *R. bungei*

**1. *Rochelia bungei*** Trautvetter, Trudy Imp. S.-Peterburgsk. Bot. Sada 9: 462. 1886.

李果鹤虱 luan guo he shi

*Lithospermum retortum* Pallas; *Rochelia disperma* Hochreutiner; *R. retorta* (Pallas) Lipsky; *R. stellulata* Reichenbach.

Plants 10–15 cm tall, gray-white hispid, hairs spreading or somewhat spreading, becoming mostly hooklike at apex on pedicel and calyx. Stems erect, usually branched from base; branches slender, ascending. Basal leaves short petiolate, oblanceolate to obovate, 1–2 cm; stem leaves sessile, lanceolate to linear, 1–2 cm, abaxially with veins protruding, apex ± obtuse. Inflorescences 5–10 cm in fruit; bracts oblanceolate to obovate, smaller than leaves. Pedicel 5–7 mm, spreading or slightly recurved. Flowers widely spaced. Calyx lobes linear, becoming semiterete, incurved, ca. 2 mm, to 4–5 mm in fruit, persistent. Corolla light blue-purple; tube almost as long as calyx; throat appendages low trapeziform; lobes of limb unequal, obovate. Anthers ca. 0.3 mm. Style persistent on apex of gynobase in fruit, surpassing nutlets, ca. 0.6 mm. Nutlets obliquely narrowly ovoid, 2–3 mm, tubercles stellate pubescent at apex. Fl. Apr–May.

Saline and alkaline areas; ca. 2700 m. N Xinjiang [Afghanistan, Kazakhstan, Kyrgyzstan, Mongolia, Russia, Tajikistan, Turkmenistan, Uzbekistan; SW Asia].

**2. *Rochelia leiocarpa*** Ledebour, Fl. Altaic. 1: 172. 1829.

光果李果鹤虱 guang guo luan guo he shi

Herbs strigose. Stems usually single, erect, branched above, 3–6 cm tall. Basal leaves narrowly obovate to obovate, 3–7 mm; stem leaves linear, 5–10 mm. Pedicel 2–3 mm in fruit. Calyx lobes linear, ca. 2 mm, arcuate inward in fruit, crisped pubescent. Corolla light blue; tube shorter than limb; lobes suborbicular. Nutlets oblique ovoid, 2–2.5 mm, glabrous or sparsely pubescent when young, yellowish white, shiny. Fl. and fr. Apr–May.

N Xinjiang [N India, Kashmir, Kazakhstan, Kyrgyzstan, Mongolia, Pakistan, Russia, Tajikistan, Turkmenistan, Uzbekistan].

**3. *Rochelia rectipes*** Stocks, Hooker's J. Bot. Kew Gard. Misc. 4: 176. 1852.

直柄李果鹤虱 zhi bing luan guo he shi

*Rochelia macrocalyx* Bunge.

Herbs annual, 2–5 cm. Branches spreading, grayish. Leaves mainly in lower part of stem, resembling a rosette, withering in fruit, oblong, 0.5–1.5 cm. Upper leaves linear,

spreading bristly, apex obtuse. Inflorescences dense, short; peduncle straight, 2–10 mm, thin; bracts linear, small. Calyx campanulate, very small, 1–1.5 mm, densely bristly, elongated to 5–7 mm in fruit; lobes free, straight, lanceolate, with sharply protruding midvein, apex slightly curved. Corolla blue, very small. Nutlets ovoid-oblong, 2–2.5 mm, with dense tubercles apically anchorlike. Fl. May–Jun, fr. Jul.

Stony slopes, gravel. NW Xizang [Afghanistan, Pakistan, Tajikistan, Uzbekistan].

**4. *Rochelia peduncularis*** Boissier, Pl. Orient., ser. 1, 7: 35. 1846.

总梗李果鹤虱 zong geng luang guo he shi

Herbs annual, grayish green, bristly pubescent. Stems 8–15 cm or more, branched from middle or above. Inflorescences terminal on branches, short, elongated in fruit. Leaves oblong-lanceolate or spatulate, 1–1.5 cm × 2–3 mm, reduced above, apex rounded. Pedicel spreading or horizontal, thick, 0.8–1.2 cm, later often recurved. Calyx small, 1.5–2 mm, accrescent in fruit; lobes lanceolate, curved outward, with hamate curved tips. Corolla blue, very small, 1–1.5 mm. Nutlets 3–4 mm, with dense white tubercles covered with very small sessile hooks. Fl. Jun, fr. Jul.

Stony slopes, gravel. W Xinjiang, NW Xizang [Afghanistan, Kazakhstan, Kyrgyzstan, Pakistan, Russia, Tajikistan, Turkmenistan, Uzbekistan; SW Asia].

**5. *Rochelia cardiosepala*** Bunge, Mém. Acad. Imp. Sci. St.-Petersbourg Divers Savans 7: 420. 1851.

心萼李果鹤虱 xin e luan guo he shi

Herbs annual, 10–40 cm, grayish green, appressed or spreading bristly. Stems branching from middle. Basal leaves few, oblong-elliptic, withering early; stem leaves linear-spatulate, 1–4 cm × 2–5 mm, long tapering at base. Inflorescences loose. Pedicel to 5–7 mm in fruit. Calyx lobes linear, small, 5–8 mm, elongated in fruit, wide, base triangular-deltate and cordate; midvein very thick, lateral veins prominent, forming a network. Corolla blue, very small, ca. 2.5 mm. Nutlets completely hidden in closed calyx, 3–4 mm, with dense tubercles minutely stellate at apex. Fl. Jun, fr. Jul.

Slopes. Weed in NW Xizang [Afghanistan, Kashmir, Kazakhstan, Kyrgyzstan, Pakistan, Russia, Tajikistan, Turkmenistan, Uzbekistan; SW Asia].



## 40. BOTHRIOSPERMUM Bunge, Enum. Pl. Chin. Bor. 47. 1833.

斑种草属 ban zhong cao shu

Herbs annual or biennial, hispid and appressed pubescent, hairs discoid at base. Stems erect or prostrate. Leaves alternate, ovate to oblanceolate. Cymes bracteate. Flowers pedicellate. Calyx 5-parted; lobes lanceolate, not enlarged or slightly enlarged in fruit. Corolla rotate, blue or white; tube short; throat appendages 5, scalelike; lobes 5, overlapping in bud, apex obtuse. Filaments extremely short; anthers 5, inserted in corolla tube, included; anthers ovate, obtuse. Ovary 4-parted, valves free, each containing 1 anatropous ovule. Style short, not surpassing valves; stigma capitate. Gynobase flat. Nutlets 4, with cupular emergence adaxially, rounded abaxially, tuberculate, with an oblong, elliptic, or orbicular ringlike aperture; margin of aperture thickened, prominent, entire or sometimes finely dentate; attachment scar basal. Seeds usually not curved.

About five species: Afghanistan, China, India, Indonesia (Java, naturalized), Japan, Kazakhstan, Korea, Kyrgyzstan, Pakistan, Russia, Tajikistan, Turkmenistan, Uzbekistan, Vietnam; all five in China.

- 1a. Nutlets with transverse ringlike aperture on adaxial surface; fruiting calyx strongly accrescent, ca. 8 mm in diam. .... 1. *B. chinense*  
1b. Nutlets with longitudinal ringlike aperture on adaxial surface; fruiting calyx slightly accrescent, to 5(–6) mm in diam.  
2a. Bracts linear to linear-lanceolate; adaxial aperture of nutlets orbicular ..... 2. *B. kusnezowii*  
2b. Bracts ovate to oblong; adaxial aperture of nutlets elliptic.  
3a. Stems appressed pubescent ..... 5. *B. zeylanicum*  
3b. Stems spreading hispid and appressed pubescent.  
4a. Cymes 3–10 cm; bracts ovate; appendages of corolla throat ca. 0.2 mm ..... 3. *B. hispidissimum*  
4b. Cymes 10–20 cm; bracts oblong to ovate-lanceolate; appendages of corolla throat ca. 0.8 mm ..... 4. *B. secundum*

### 1. *Bothriospermum chinense* Bunge, Enum. Pl. Chin. Bor. 47. 1833.

斑种草 ban zhong cao

*Bothriospermum bicarunculatum* Fischer & C. A. Meyer.

Herbs annual, rarely biennial, 20–30 cm tall, densely spreading or appressed hispid. Stems several, cespitose, erect or ascending, branched above or simple. Basal and lower stem leaves long petiolate, spatulate or oblanceolate, usually 3–6 × 1–1.5 cm, hirsute or appressed pubescent, hairs discoid at base, base attenuate, margin crisped or entire, apex obtuse; middle and upper stem leaves sessile, oblong to narrowly oblong, 1.5–2.5 cm × 5–10 mm, base cuneate to broadly cuneate, apex acute. Inflorescences 5–15 cm; bracts ovate to narrowly ovate. Pedicel 2–3 mm, elongated in fruit. Calyx 2.5–4 mm, spreading hispid and short appressed, pubescent outside; lobes lanceolate, fruiting calyx accrescent, ca. 8 mm wide. Corolla pale blue, 3.5–4 mm; throat appendages trapeziform, slightly 2-cleft at apex; limb 4–5 mm wide; lobes orbicular, ca. 1 mm wide. Stamens inserted ca. 1 mm above base; anthers ovate to oblong, ca. 0.7 mm. Style ca. 1/2 as long as calyx. Nutlets reniform, ca. 2.5 mm, wrinkled, densely tuberculate, aperture transversely elliptic. Fl. Apr–Jun.

• Hillside meadows, roadsides; 100–1600 m. Gansu, Hebei, Henan, Liaoning, Shaanxi, Shandong, Shanxi.

### 2. *Bothriospermum kusnezowii* Bunge, Delect. Seminum Collect. Anni 7. 1840.

狭苞斑种草 xia bao ban zhong cao

*Bothriospermum decumbens* Kitagawa.

Herbs annual, 15–40 cm tall. Stems several, cespitose, erect or prostrate, much branched from below, spreading hispid and short appressed pubescent. Basal leaves rosulate, oblanceolate to spatulate, 4–7 cm × 5–10 mm, sparsely hispid and appressed pubescent, base attenuate, margin undulate, finely dentate, apex obtuse; stem leaves sessile, oblong to linear-oblanceolate, 2–5 cm × 5–10 mm. Inflorescences 5–20 cm; bracts linear to linear-lanceolate, 15–30 × 2–5 mm, densely hispid and appressed pubescent. Pedicel 1–2.5 mm, elongated in fruit. Calyx 2–3 mm, to 5 mm in fruit, densely spreading hispid and minutely hispid outside, appressed pubescent above middle inside; lobes linear-lanceolate to ovate-lanceolate, apex acute. Corolla blue or purple, campanulate, 3.5–4 mm; throat appendages trapeziform, ca. 0.7 mm, 2-cleft at apex; limb ca. 5 mm wide; lobes orbicular, with conspicuous reticulate veins. Filaments inserted ca. 1 mm above base in corolla tube; anthers elliptic to ovoid, ca. 0.7 mm. Style ca. 1/2 as long as calyx; stigma capitate. Nutlets ellipsoid, 2–2.5 mm, densely tuberculate, aperture orbicular, margin thickened, entire. Fl. and fr. May–Jul.

• Roadsides, dry fields, forest margins in valleys; 800–2500 m. Gansu, Hebei, Heilongjiang, Jilin, Nei Mongol, Ningxia, Qinghai, Shaanxi, Shanxi.

### 3. *Bothriospermum hispidissimum* Handel-Mazzetti, Anz. Akad. Wiss. Wien. Math.-Nat. Kl. 57: 240. 1920.

云南斑种草 yun nan ban zhong cao

Herbs biennial, 30–40 cm tall. Stems several, cespitose, erect or ascending, branched, spreading hispid and appressed pubescent. Basal leaves forming a rosette; leaf blade 5–6 cm

× 7–12 mm, abaxially densely strigose, adaxially scabrous, densely hirsute and appressed pubescent, hairs discoid at base, base attenuate, apex obtuse or acute; lower stem leaves sessile, oblanceolate, base cuneate, apex obtuse; upper stem leaves sessile, oblong or oblong-lanceolate, 1.5–3 cm × 5–10 mm, apex acute, broadly cuneate or rounded. Inflorescences terminal and lateral, 3–10 cm; bracts ovate, 5–8 × 3–5 mm. Pedicel very short, densely spreading hispid. Calyx 1.5–2 mm, slightly enlarged after anthesis, densely yellow hispid and strigose outside, densely appressed pubescent inside; lobes lanceolate to ovate-lanceolate. Corolla blue or purple, ca. 3 mm; throat appendages trapeziform, ca. 0.2 mm, apex retuse; limb ca. 4 mm wide; lobes orbicular, ca. 1 mm wide. Filaments inserted ca. 0.5 mm above base of corolla tube; anthers ovoid. Style terete, less than 1/2 as long as calyx; stigma capitate. Nutlets ca. 1 mm, densely granulate, aperture longitudinally elliptic, margin irregular, finely dentate.

• Roadsides, forests; 1600–1900 m. SW Sichuan, Yunnan.

**4. *Bothriospermum secundum*** Maximowicz, Mém. Acad. Imp. Sci. Saint Pétersbourg 9: 202. 1859.

多苞斑种草 duo bao ban zhong cao

Herbs annual or biennial, 25–40 cm tall, with straight roots. Stems single or several, cespitose, branched from base, spreading hispid and appressed pubescent; branches usually slender. Basal leaves petiolate, obovate-oblong, 2–5 cm, base attenuate, apex obtuse; stem leaves sessile, oblong to ovate-lanceolate, 2–4 cm × 5–10 mm, minutely hispid, hairs discoid at base. Inflorescences terminal and axillary, 10–20 cm, flowers and bracts individually secund; bracts oblong to ovate-lanceolate, 0.5–1.5 cm × 3–5 mm, hispid, short appressed pubescent. Pedicel pendulous, 2–3 mm, scarcely elongated in fruit. Calyx 2.5–3 mm, densely hispid outside; lobes lanceolate. Corolla blue to pale blue, 3–4 mm; throat appendages trapeziform, ca. 0.8 mm, retuse at apex; limb 4–5 mm wide; lobes orbicular. Filaments inserted ca. 1 mm above base; anthers oblong, ca. as long as appendages. Style terete,

ca. 1/3 as long as calyx. Nutlets ellipsoid-ovoid, ca. 2 mm, densely tuberculate, aperture longitudinally elliptic. Fl. May–Jul.

• Hillsides, roadsides, riverbeds, forest margins, thickets, shaded moist places; 300–2100 m. Gansu, Hebei, Heilongjiang, Jiangsu, Jilin, Liaoning, Shaanxi, Shandong, Shanxi, Yunnan.

**5. *Bothriospermum zeylanicum*** (J. Jacquin) Druce, Bot. Exch. Cl. Brit. Isles 4: 610. 1917.

柔弱斑种草 rou ruo ban zhong cao

*Anchusa zeylanica* J. Jacquin, Ecl. Pl. Rar. 1: 47, t. 29. 1812; *A. tenellum* Hornemann; *Bothriospermum asperugoides* Siebold & Zuccarini; *B. tenellum* (Hornemann) Fischer & C. A. Meyer; *B. tenellum* var. *asperugoides* (Siebold & Zuccarini) Maximowicz.

Herbs annual, 15–30 cm tall. Stems slender, crowded, erect or prostrate, much branched, appressed hispid. Leaf blade elliptic to narrowly elliptic, 1–2.5 cm × 5–10 mm, sparsely short appressed bristly or strigose, base broadly cuneate, apex obtuse, mucronulate. Racemes numerous, lax after anthesis; lower bracts few, lanceolate, 1.5–5 mm, apex acute; upper bracts very small. Pedicel 1–2 mm, not elongated or somewhat elongated in fruit. Calyx 1–1.5 mm, to 3 mm in fruit, with short ascending white bristles. Corolla blue or pale blue, 1.5–1.8 mm, base ca. 1 mm wide, slightly longer than calyx; throat appendages ca. 0.2 mm; limb 2.5–3 mm wide; lobes orbicular, ca. 1 mm. Style terete, ca. 0.5 mm. Nutlets gray, oval-reniform, 1–1.2 mm, aperture longitudinally elliptic. Fl. and fr. Feb–Oct.

Grain fields, hillside meadows, river banks, shaded moist areas. Fujian, Guangdong, Guangxi, Guizhou, Hainan, Hebei, Heilongjiang, Hunan, Jiangxi, Jilin, Liaoning, Nei Mongol, Ningxia, Shaanxi, Shandong, Shanxi, Sichuan, Taiwan, Yunnan, Zhejiang [Afghanistan, India, Indonesia (Java, naturalized), Japan, Kazakhstan, Korea, Kyrgyzstan, Pakistan, Russia, Tajikistan, Turkmenistan, Uzbekistan, Vietnam].

**41. *ANTIOTREMA*** Handel-Mazzetti, Anz. Akad. Wiss. Wien. Math.-Nat. Kl. 57: 239. 1920.

长蕊斑种草属 chang rui ban zhong cao shu

Herbs perennial, pubescent or hispid; stems erect, leafy. Basal leaves forming a rosette. Cymes in terminal paniculate clusters, ebracteate. Flowers short pedicellate. Calyx 5-parted more than 2/3 length, slightly enlarged in fruit. Corolla light blue or pale purplish red, funnellform; appendages borne below middle of corolla tube, oblong, papillose, apex obtuse; lobes orbicular, more than 2 × as long as tube. Stamens equal, exerted, inserted between appendages, lower part of filaments adnate to corolla tube; anthers oblong, obtuse. Gynobase flat. Nutlets erect, semiovoid, adaxial aperture 2-layered, longitudinal, ringlike, abaxially convex, tuberculate, inside layer membranous; attachment scar basal, orbicular-triangular. Style persistent, ca. 2 × as long as nutlets; embryo straight, erect.

One species: endemic to China.

**1. *Antiotrema dunnianum*** (Diels) Handel-Mazzetti, Anz. Akad. Wiss. Wien. Math.-Nat. Kl. 57: 240. 1920.

长蕊斑种草 chang rui ban zhong cao

*Cynoglossum dunnianum* Diels, Notes Roy. Bot. Gard. Edinburgh 5: 168. 1912; *C. cavaleriei* H. Léveillé; *Henryetana mirabilis* Brand.

Stems 1 or 2, branched only at inflorescences, 10–30 cm tall, densely pubescent. Basal leaves spatulate to narrowly elliptic, 3–18 × 1–5 cm, densely minutely hispid, hairs discoid at base, apex obtuse to acute; stem leaves smaller, oblanceolate to narrowly obovate-oblong. Inflorescences terminal, branched, densely pubescent, many flowered. Pedicel 2–3 mm, slightly recurved. Calyx 3.5–4 mm; lobes linear-lanceolate to triangular-lanceolate, apex acute, slightly

enlarged. Corolla blue or purple-red, 4.5–7 mm, glabrous; appendages trapeziform, 1–1.4 mm, papillate along margin, apex obtuse; lobes of limb spreading, suborbicular, more than 2 × as long as tube, margin entire, veined. Filaments filiform; anthers ca. 0.8 mm. Ovary 4-parted, usually with 1–3 valves developing. Style filiform, 4–5 mm. Nutlets brown, slightly incurved, 2.2–2.5 mm, densely tuberculate, aperture occupying ± entire adaxial surface, outside layer with

tuberclelike teeth, inside layer entire. Seeds narrowly ovoid, dorsiventrally compressed; radicle inferior. Fl. May–Jun, fr. Jul–Aug.

- Hillside meadows, *Pinus* and broadleaved forests, thickets, forest margins, roadsides; 1600–2500 m. W Guangxi, Guizhou, SW Sichuan, Yunnan.

## 42. CYNOGLOSSUM Linnaeus, Sp. Pl. 1: 134. 1753.

琉璃草属 liu li cao shu

Herbs perennial or biennial, rarely annual. Leaves usually basal and stem, entire; basal and lower stem leaves usually long petiolate. Cymes terminal or axillary, crowded or often dichotomously branched spreading panicles, bracteate or ebracteate. Flowers pedicellate. Calyx 5-parted to base, enlarged in fruit; lobes reflexed or spreading. Corolla usually blue, rarely white, dark purplish red, blackish purple or yellow-green, campanulate, tubular or funnelliform, 5-parted; tube ± shorter than calyx; throat appendages 5, ± square, trapeziform or lunate, depressed at apex; lobes ovate to orbicular. Stamens included, inserted at middle or above in corolla tube; anthers ovoid or oblong. Style filiform, terete or somewhat tetragonous; stigma capitate, not exerted; ovary 4-parted; ovule anatropous. Gynobase fastigiate to conical. Nutlets 4, ovoid to subglobose, with glochids, attachment scar subapical.

About 75 species: cosmopolitan, primarily in Africa, Asia, and Europe, 12 species in China.

- 1a. Plants 8–15 cm tall, caespitose, high alpine plants; basal leaf blades 2–4 cm × 5–10 mm ..... 12. *C. schlagintweitii*  
 1b. Plants more than 15 cm tall, rarely caespitose; basal leaf blades larger.  
 2a. Nutlets ca. 5 mm in diam. or larger.  
 3a. Inflorescences with linear-lanceolate bracts.  
 4a. Fruiting pedicel 2–4 cm; abaxial surface of nutlets flat, without keel; calyx lobes ovate to ovate-lanceolate ..... 1. *C. divaricatum*  
 4b. Fruiting pedicel to 1 cm; abaxial surface of nutlets concave, keeled along center line; calyx lobes linear to linear-lanceolate ..... 5. *C. gansuense*  
 3b. Inflorescences ebracteate.  
 5a. Basal and lower stem leaves cordate to cordate-orbicular; nutlets to 15 mm in diam. .... 3. *C. triste*  
 5b. Basal and lower stem leaves oblong; nutlets 5–8 mm in diam.  
 6a. Leaf blade 7–9 cm wide; corolla greenish yellow; lobes of fruiting calyx 2.5–4 mm ..... 4. *C. viridiflorum*  
 6b. Leaf blade 1–5 cm wide; corolla blue-purple; lobes of fruiting calyx ca. 10–15 mm ..... 2. *C. macrocalycinum*  
 2b. Nutlets 2–5 mm in diam.  
 7a. Nutlets 4–5 mm in diam.; leaves gray-green, densely pubescent; inflorescences numerous, paniculate; limb of corolla 8–10 mm wide ..... 7. *C. amabile*  
 7b. Nutlets 2–3.5 mm in diam.; leaves green to grayish green; inflorescences not crowded; limb of corolla 2.5–7 mm wide.  
 8a. Inflorescences not branched ..... 6. *C. wallichii*  
 8b. Inflorescences branched.  
 9a. Corolla 1.5–2.5 mm.  
 10a. Pedicel 1–1.5 mm; plants perennial ..... 11. *C. lanceolatum*  
 10b. Pedicel 3–5 mm; plants annual or biennial ..... 10. *C. formosanum*  
 9b. Corolla 3.5–5 mm.  
 11a. Plants long villous ..... 9. *C. alpestre*  
 11b. Plants densely strigose ..... 8. *C. furcatum*

**1. *Cynoglossum divaricatum*** Stephan ex Lehmann, Pl. Asperif. Nucif. 161. 1818.

大果琉璃草 da guo liu li cao

Herbs perennial, 25–100 cm tall. Roots red-brown, straight, stout. Stems erect, hollow, ribbed, branched above, appressed pilose; branches spreading. Basal and lower stem leaves gray-green, oblong-lanceolate to lanceolate, 7–15 × 2–4 cm, densely appressed pubescent, base attenuate, apex obtuse to acuminate; middle and upper stem leaves sessile,

narrowly lanceolate, gray pubescent. Inflorescences paniculate, terminal or axillary, ca. 10 cm; bracts narrowly lanceolate to linear. Pedicel slender, 3–10 mm, to 2–4 cm in fruit, recurved, densely appressed pilose. Flowers widely spaced. Calyx 2–3 mm, pubescent outside; lobes reflexed, ovate to ovate-lanceolate, scarcely enlarged in fruit. Corolla blue-purple, ca. 3 mm, parted to lower 1/3; throat appendages trapeziform, ca. 0.5 mm; limb 3–5 mm wide; lobes ovate-orbicular, apex retuse. Stamens inserted above middle of corolla tube; anthers ovoid, ca. 0.6 mm. Nutlets ovoid, 4.5–6

× ca. 5 mm, with dense glochids, adaxially flat; attachment scar orbicular, above middle.

Dry slopes, dunes, rocky marshes, roadsides, meadows; 500–2500 m. Gansu, Hebei, Heilongjiang, Jilin, Liaoning, Nei Mongol, Ningxia, Shaanxi, Shandong, Shanxi, Xinjiang [Kazakhstan, Mongolia, Russia].

The roots are used medicinally.

## 2. *Cynoglossum macrocalycinum* Riedl, Novon 4: 46. 1994.

大萼琉璃草 da e liu li cao

Herbs biennial, stout, at least 50–60 cm tall. Stems with few branches in leaf axils, with patent or slightly reflexed white hairs. Lowermost leaves indistinctly petiolate; upper middle leaves sessile, oblong-lanceolate, 13–14 × 3–3.5 cm, base attenuate, apex ± acute; uppermost leaf blade ovate to oblong-lanceolate, 5.5–11 × 2–3 cm, base often abruptly contracted or rounded, apex acute to ± obtuse; leaves of lateral branches lanceolate to linear-lanceolate, (3–)6–9 × 0.8–1.8 cm; leaf indumentum of ± patent, curved hairs of different lengths. Cymes short, widely spaced at apex, ebracteate. Pedicel ca. 1 cm at anthesis, to 3 cm in fruit, densely white pubescent, straight at first, slightly recurved later along upper 1/3. Calyx 8–9 mm at anthesis; lobes free to base, imbricately covering each other along margin, ovate to ovate-oblong, elongated to 1–1.5 cm after anthesis, unequal in length and width, widest to 5 mm, narrowest ca. 2.5 mm, often also shorter than others, all subexplanate, densely white patent pubescent, apex broadly obtuse. Corolla dark purple, campanulate, exceeding calyx, 9–9.5 mm wide, with reticulate veins; tube ca. 5 mm, ca. as long as limb; faucal appendages large, subquadrate, larger than anthers; lobes to 2 mm, very broadly rounded. Style short, included in corolla; ovary not enlarged after anthesis. Mature nutlets unknown.

• Shaded moist slopes, valleys, meadows; 1500–1800 m. N Xinjiang.

The plants are used medicinally.

## 3. *Cynoglossum triste* Diels, Notes Roy. Bot. Gard. Edinburgh 5: 169. 1912.

心叶琉璃草 xin ye liu li cao

Herbs perennial, 15–50 cm tall. Stems several and cespitose or single, erect, stout, hispid. Basal and lower stem leaves long petiolate, cordate to ovate-orbicular, 5–12 × 3.5–8 cm, base entire to repand, apex acute, cordate to rounded, slightly appressed hispid, hairs discoid at base; upper stem leaves short petiolate, cordate to oblong-ovate, 6–9 × 3–6 cm; lateral veins 3 or 4 pairs. Inflorescences 3–6, becoming terminally clustered, ebracteate. Pedicel 2–2.5 mm, elongated after anthesis. Calyx 5–6 mm; lobes lanceolate to lanceolate-oblong, 1.5–2 mm wide, enlarged after anthesis, hirsute. Corolla black-purple, tubular, 5–6 mm, base ca. 3 mm wide; throat appendages trapeziform, 1.5–2 × ca. 1 mm; limb 8–10 mm wide; lobes subovate, obtuse-mucronate at apex. Anthers oblong, ca. as long as appendages. Style terete, 2–2.5 mm. Nutlets depressed, to 1.5 cm in diam., abaxially convex; glochids dense, yellow, ca. 2 mm. Fl. May-Jul.

• Shaded moist slopes, *Pinus* forests; 2500–3100 m. SW Sichuan, NW Yunnan.

## 4. *Cynoglossum viridiflorum* Pallas ex Lehmann, Pl. Asperif. Nucif. 1: 160. 1818.

绿花琉璃草 lu hua liu li cao

Herbs perennial, 50–100 cm tall. Stems stout, ribbed, glabrous. Basal and lower stem leaves oblong-elliptic, 15–25 × 7–9 cm, abaxially gray-green, densely pubescent, adaxially green and glabrous, base attenuate, apex acuminate; middle and upper stem leaves short petiolate or sessile, oblong to lanceolate, 10–15 × 3–5 cm. Inflorescences terminal or axillary, paniculate, ebracteate. Pedicel 1.5–3 mm, to 1 cm after anthesis, recurved, densely white pilose. Calyx 2.5–4 mm, appressed pubescent outside; lobes oblong-linear. Corolla greenish yellow, 4.5–5.5 mm, base 1–1.5 mm wide; throat appendages trapeziform, ca. 1.5 × 1 mm; limb 5–6 mm wide; lobes orbicular. Stamens inserted on middle of corolla tube; anthers oblong, ca. as long as appendages. Style ca. 1.5 mm. Nutlets ovoid to rhombic-ovoid, 5–7 × 4.5–5.5 mm; prickles dense, anchorlike, abaxially concave, obscurely keeled or without keels along center line; attachment scar above middle adaxially, ovate-oblong. Fl. May-Jun, fr. Jul-Aug.

Stream banks, thicket margins, rocky crevices; 700–1700 m. N Xinjiang [Kazakhstan, Kyrgyzstan, Russia, Tajikistan, Turkmenistan, Uzbekistan].

## 5. *Cynoglossum gansuense* Y. L. Liu, Acta Phytotax. Sin. 19: 519. 1981.

甘青琉璃草 gan qing liu li cao

Herbs perennial, 30–60 cm. Stems erect, woody at base, branched above, appressed or spreading hispid, hairs discoid at base. Lower stem leaves linear-lanceolate, 9–16 × 1–1.5 cm, abaxially densely white pilose, adaxially densely short appressed hirsute, hairs discoid at base, base attenuate, margin entire to repand, apex acuminate. Inflorescences terminal and lateral, becoming more contracted paniculate, with lanceolate bracts. Pedicel 1–1.5 mm, to 1 cm in fruit. Calyx 4–5 mm; lobes spreading, linear to linear-lanceolate, to 1.3 cm in fruit, strigose and hispid outside, hairs discoid at base, pilose inside. Corolla blue, base 3–5 mm wide; throat appendages trapeziform, ca. 0.5 mm; limb 3–6 mm wide; lobes orbicular. Stamens inserted at middle of corolla tube; filaments ca. 0.7 mm; anthers oblong, ca. 1 mm. Style ca. 1.5 × 0.5 mm. Nutlets ovoid to long ovoid, 5–6.5 mm, with dense glochids; abaxially slightly concave, ± keeled along center line; attachment scar at apex adaxially, rhomboid-ovate. Fl. Jul.

• Hillside meadows, in tussocks at forest margins, fields, roadsides; 1600–2900 m. C and SE Gansu, E Qinghai, S Ningxia, N Sichuan.

## 6. *Cynoglossum wallichii* G. Don, Gen. Hist. 4: 354. 1837.

西南琉璃草 xi nan liu li cao

Herbs biennial, 20–60(–70) cm tall. Stems single or several and cespitose, branched above, densely hispid, hairs discoid at base; branches slender, spreading. Basal and lower stem leaves petiolate, green to gray-green, lanceolate to

obovate, 2–5 cm × 5–12 mm; middle and upper stem leaves ± sessile, green to gray-green, smaller, sparsely hispid and appressed pubescent. Inflorescences terminal and axillary, forked, to 20 cm in fruit, becoming racemelike, many flowered at anthesis, ebracteate. Pedicel ca. 5 mm in fruit, recurved. Calyx 2–2.5 mm, densely and antrorsely appressed pilose; lobes erect, ovate to oblong, ca. 2 × 0.5 mm, slightly enlarged in fruit, margin ciliate. Corolla blue or blue-purple, campanulate, base 3–4 mm wide; throat appendages trapeziform, ca. 0.7 mm, margin pubescent; limb 2.5–4.5 mm wide; lobes orbicular; veins distinctly reticulate. Anthers oblong, 0.8–1 mm. Nutlets ovoid, 3–4 × 2.5–3 mm; abaxially concave, with glochids, base of marginal glochids expanded and confluent forming a wing, apex of nutlets rounded to acute. Fl. and fr. May–Aug.  $2n = 24$ .

Hillside meadows, forests, forest margins, slopes, roadsides; 1300–3600 m. Gansu, Qinghai, Sichuan, Xizang, Yunnan [Afghanistan, Bhutan, India, Kashmir, Myanmar, Nepal, Pakistan].

- 1a. Abaxial surface of nutlets with sparse to dense glochids; marginal glochids numerous, expanded and confluent into a broad wing ..... 6a. var. *wallichii*  
1b. Abaxial surface of nutlets with glochids only along center line keel; marginal glochids slightly expanded and confluent into a narrow wing ..... 6b. var. *glochidiatum*

#### 6a. *Cynoglossum wallichii* var. *wallichii*

西南琉璃草 (原变种) xi nan liu li cao (yuan bian zhong)

*Cynoglossum denticulatum* A. de Candolle; *C. edgeworthii* A. de Candolle.

Abaxial surface of nutlets with sparse to dense glochids, marginal glochids numerous, expanded and confluent into a broad wing.

Hillside meadows, moist shaded forests; 1300–3600 m. S Gansu, W Sichuan, SE Xizang, NW Yunnan [Afghanistan, Bhutan, India, Nepal, Pakistan].

6b. *Cynoglossum wallichii* var. *glochidiatum* (Wallich ex Benth) Kazmi, J. Arnold Arbor. 52: 347. 1971.

倒钩西南琉璃草 dao gou xi nan liu li cao

*Cynoglossum glochidiatum* Wallich ex Benth in Royle, Ill. Bot. Himal. Mts. 1: 306. 1839.

Abaxial surface of nutlets with glochids only along center line keel, marginal glochids slightly expanded and confluent into a narrow wing.  $2n = 24$ .

Forest margins, slopes, roadsides. S Gansu, Qinghai, N and SW Sichuan, S Xizang, SW Yunnan [Afghanistan, Bhutan, India, Kashmir, Myanmar, Nepal, Pakistan].

7. *Cynoglossum amabile* Stapf & J. R. Drummond, Bull. Misc. Inform. Kew 1906: 202. 1906.

倒提壶 dao ti hu

Herbs perennial 15–60 cm tall. Stems single or several and cespitose, densely spreading pubescent. Basal leaves long

petiolate, gray-green, oblong-lanceolate to lanceolate, 5–20 cm, densely pubescent; stem leaves sessile, gray-green, oblong to lanceolate, 2–7 cm; lateral veins conspicuous. Inflorescences paniculate, ebracteate. Pedicel 2–3 mm, slightly elongated in fruit. Calyx 2.5–3.5 mm, densely pilose outside; lobes ovate to oblong, apex acute. Corolla usually blue, rarely white, base 5–6 mm wide; throat appendages trapeziform, ca. 1 mm; limb 8–10 mm wide; lobes orbicular, ca. 2.5 mm; veins distinctly reticulate. Anthers oblong, ca. 1 mm. Style linear-terete. Nutlets ovoid, 3–4 mm; adaxially slightly concave, with dense glochids; base of marginal glochids confluent, ± forming a wing; attachment scar above middle abaxially, triangular. Fl. and fr. May–Sep.  $2n = 24$ .

Hillside meadows, forests, thickets, roadsides, river banks; 2600–3700 m. Gansu, Guizhou, Sichuan, Xizang, Yunnan [Bhutan].

- 1a. Nutlets slightly concave abaxially, with dense glochids ..... 7a. var. *amabile*  
1b. Nutlets keeled along center line abaxially, with glochids usually only on keel ..... 7b. var. *pauciglochidiatum*

#### 7a. *Cynoglossum amabile* var. *amabile*

倒提壶(原变种) dao ti hu (yuan bian zhong)

Nutlets slightly concave abaxially, with dense glochids.

Hillside meadows, roadsides, thickets, coniferous forests; 2600–3700 m. S Gansu, W Guizhou, W Sichuan, SE and SW Xizang, Yunnan [Bhutan].

7b. *Cynoglossum amabile* var. *pauciglochidiatum* Y. L. Liu, Acta Phytotax. Sin. 19: 520. 1981.

滇西倒提壶 dian xi dao ti hu

Nutlets keeled abaxially along center line, with glochids usually only on keel.

• Hillside meadows, river banks, forests; 2600–3700 m. N and SW Sichuan, NW Yunnan.

8. *Cynoglossum furcatum* Wallich in Roxburgh, Fl. Ind. 2: 6. 1824.

琉璃草 liu li cao

Herbs erect, 40–60 cm tall. Stems single or several and cespitose, densely yellowish brown strigose. Basal and lower stem leaves long petiolate, oblong to oblong-lanceolate, 15–20 × 3–5 cm, densely appressed pubescent, base attenuate, apex obtuse; upper stem leaves sessile, smaller. Inflorescences terminal and axillary, subdichotomously branching; branches spreading at obtuse angle, ebracteate. Pedicel 1–2 mm, shorter than calyx in fruit, densely strigose. Calyx 1.5–2 mm, slightly enlarged to ca. 3 mm in fruit; lobes ovate to ovate-oblong, densely strigose outside. Corolla blue, funnellform, base 3.5–4.5 mm wide; throat appendages trapeziform, ca. 1 mm, margin densely white pilose, apex retuse; limb 5–7 mm wide; lobes oblong, apex rounded. Filaments expanded at base; anthers oblong, ca. 1 × 0.5 mm. Style somewhat tetragonous, ca. 1–2.5 mm. Nutlets ovoid-globose, 2–3 × 1.5–2.5 mm, abaxially concave, with dense glochids, margin wingless or winged below middle. Fl. and fr. May–Oct.  $2n = 24$ .

Forest meadows, sunny slopes; 300–3000 m. Fujian, S Gansu, Guangdong, Guangxi, Guizhou, Hainan, Henan, Hunan, Jiangsu, Jiangxi, Shaanxi, Sichuan, Taiwan, Yunnan, Zhejiang [Afghanistan, India, Japan, Malaysia, Pakistan, Philippines, Thailand, Vietnam].

- 1a. Inflorescences much branched, with short branches; leaf blades often with long soft hairs; glochids on abaxial surface of nutlets numerous ..... 8a. var. *furcatum*  
1b. Inflorescences less branched, with elongated branches; leaf blades short pubescent; glochids on abaxial surface of nutlets less abundant ..... 8b. var. *villosulum*

**8a. *Cynoglossum furcatum* var. *furcatum***

琉璃草 (原变种) liu li cao (yuan bian zhong)

Leaves small, with long soft hairs. Inflorescences branched; branches short. Glochids on abaxial surface of nutlets numerous.

Forest meadows, sunny slopes; 300–3000 m. Fujian, S Gansu, Guangdong, Guangxi, Guizhou, Hainan, Henan, Hunan, Jiangsu, Jiangxi, Shaanxi, Sichuan, Taiwan, Yunnan, Zhejiang [Afghanistan, India, Japan, Malaysia, Pakistan, Philippines, Thailand, Vietnam].

The roots are used medicinally.

**8b. *Cynoglossum furcatum* var. *villosulum* (Nakai) Riedl, Novon 4: 46. 1994.**

短毛琉璃草 duan mao liu li cao

*Cynoglossum villosulum* Nakai, Bot. Mag. (Tokyo) 37: 6. 1923.

Leaves larger, short pubescent. Inflorescences less branched; branches elongate. Glochids on abaxial surface of nutlets fewer.

China [Japan].

**9. *Cynoglossum alpestre* Ohwi, Acta Phytotax. Geobot. 2: 150. 1933.**

高山倒提壶 gao shan dao ti hu

Herbs perennial, long villous. Stems to 50 cm tall, few branched above. Basal leaves linear-lanceolate or oblanceolate, base attenuate, margin entire, apex acute; stem leaves sessile, linear-lanceolate. Racemes erect, elongated to 11 cm, often 2-branched at base, ebracteate. Pedicel short. Calyx lobes ovate, 2–3 mm, ca. 5 mm in fruit, pubescent outside. Corolla blue, ca. 5 mm across; tube 3–4 mm; lobes spreading, ca. 2 mm, rounded; scales reniform, emarginate at apex. Filaments short. Nutlets 4, compressed, ovate, ca. 3 mm wide, with long glochids.

- Alpine areas; 1200–2500 m. Taiwan.

**10. *Cynoglossum formosanum* Nakai, Bot. Mag. (Tokyo) 37: 4. 1923.**

台湾琉璃草 tai wan liu li cao

Herbs annual or biennial. Petiole of basal leaves ca. 3.5 cm; leaf blade lanceolate, ca. 10 cm, abaxially equally

setulose, adaxially densely setulose, apex cartilaginous; veins elevated; stem leaves lanceolate, abaxially soft pubescent. Inflorescences branched, 3–10 cm in fruit. Pedicel 3–5 mm, pilose. Calyx 5-parted; lobes oblong, ca. 1.5 mm, to 2–3 mm in fruit, setulose, inside glabrous. Corolla pale blue, campanulate, 5-lobed. Style persistent. Nutlets homogenous, dark brown, with glochids.

Taiwan [Japan].

**11. *Cynoglossum lanceolatum* Forsskål, Fl. Aegypt.-Arab. 41. 1775.**

小花琉璃草 xiao hua liu li cao

*Cynoglossum canescens* Willdenow; *C. hirsutum* Thunberg; *C. micranthum* Poirlet; *C. racemosum* Roxburgh.

Herbs perennial, 20–90 cm tall. Stems erect, branched from middle or below, densely hispid, hairs discoid at base; branches spreading. Basal and lower stem leaves petiolate, oblong-lanceolate, 8–14 × ca. 3 cm, abaxially densely pubescent, adaxially hispid and densely appressed pubescent, hairs discoid at base, base attenuate, apex acute; upper stem leaves sessile or short petiolate, lanceolate, smaller. Inflorescences terminal and axillary; branches spreading at an obtuse angle, ebracteate. Pedicel 1–1.5 mm, scarcely elongated in fruit. Calyx 1–1.5 mm; lobes ovate, densely short appressed pubescent outside, glabrous inside, slightly enlarged in fruit, apex obtuse. Corolla light blue, campanulate, 1.5–2.5 mm; throat appendages lunate; limb 2–2.5 mm wide. Anthers ovoid, ca. 0.5 mm. Style tetragonous, ca. 1 mm. Nutlets ovoid-globose, 2–2.5 mm, abaxially concave, with dense glochids, marginal glochids not confluent at base. Fl. and fr. Apr-Sep.  $2n = 24$ .

Hills, meadows, roadsides; 300–2800 m. Fujian, S Gansu, Guangdong, Guangxi, Guizhou, Hainan, Henan, Hunan, Jiangsu, Jiangxi, Shaanxi, Sichuan, Taiwan, Yunnan, Zhejiang [Cambodia, N India, Kashmir, Laos, Malaysia, Myanmar, Nepal, Pakistan, Philippines, Sri Lanka, N Thailand; Africa, SW and W Asia].

Used medicinally.

**12. *Cynoglossum schlagintweitii* (Brand) Kazmi, J. Arnold Arbor. 52: 352. 1971.**

西藏琉璃草 xi zang liu li cao

*Adelocaryum schlagintweitii* Brand, Repert. Spec. Nov. Regni Veg. 13: 548. 1915.

Herbs suffrutescent, 8–15 cm tall. Stems several, cespitose, erect or ascending, upwardly pilose. Basal leaves long petiolate, oblanceolate to obovate, 2–4 cm × 5–10 mm, abaxially densely appressed pubescent, adaxially sparsely hispid, hairs discoid at base, base attenuate, apex obtuse; stem leaves short petiolate or sessile, 0.6–1.5 cm. Inflorescences solitary, rarely branched, terminal, 6–10 mm. Pedicel 1–1.5 mm, to 3 mm after anthesis, recurved. Flowers widely spaced. Calyx 1–1.5 mm, densely hispid, short appressed pubescent outside, glabrous inside; lobes oblong, apex obtuse. Corolla blue or blue-purple, campanulate, base 2–4 mm wide; throat appendages lunate; limb 3–5 mm wide; lobes divaricate, broadly ovate. Anthers oblong, 0.5–0.7 mm. Nutlets ovoid, 3–4 mm; abaxially flat, with scattered glochids; base of marginal

glochids expanded and confluent into a broad wing. Fl. Jun, fr. Jul-Aug.

Gravelly slopes, forests; 2500–4000 m. SW Xizang [India].

According to Robert R. Mill (in litt.), *Paracaryum trinervum* Duthie (Bull. Misc. Inform. Kew 1912: 39. 1912) and *Cynoglossum schlaginweirii*, both described from Xizang, are probably conspecific. If so, the epithet *trinervum* needs to be transferred to *Cynoglossum*.

### 43. LINDELOFIA Lehmann, Neue Allg. Deutsche Garten-Blumenzeitung 6: 351. 1850.

长柱琉璃草属 chang zhu liu li cao shu

Herbs perennial, erect, pubescent or villous. Basal leaves long petiolate; stem leaves alternate, entire. Cymes ebracteate. Calyx 5-parted to base; lobes lanceolate to linear-oblong, slightly enlarged in fruit. Corolla funnellform; tube usually longer than calyx; throat appendages elongated, curved, or oblong, rarely reduced, becoming ovate, entire at apex; lobes of limb subvertical or spreading, obtuse. Stamens inserted below throat; anthers elongated, frequently hastate at base, exerted from throat. Style filiform, exerted, thickened and persistent in fruit. Gynobase short conical. Nutlets dorsiventrally compressed, ovate, ca. 6 mm, abaxially discoid with glochids; attachment scar above middle adaxially, ovate, firmly coherent to gynobase.

About ten species: C and W Asia; one species in China.

1. *Lindelofia stylosa* (Karelin & Kirilov) Brand in Engler, Pflanzenz. IV. 252 (Heft 78): 85. 1921.

长柱琉璃草 chang zhu liu li cao

Roots stout, to 2 cm in diam. Stems usually branched above, 20–100 cm tall, appressed pubescent. Basal petioles complanate, narrowly winged, subglabrous, oblong-elliptic to oblong-linear, 8–25(–35) cm, sparsely short appressed pubescent, base attenuate; lower stem leaves petiolate, sublinear; upper stem leaves sessile or nearly so, narrowly lanceolate. Inflorescences 3–7 cm, to 20 cm in fruit, densely appressed pubescent. Pedicel 2.5–4 mm, to 3 cm in fruit. Calyx lobes slightly unequal, subulate-linear, 5–6 mm. Corolla purple or purplish red, 8–11 mm, glabrous; tube straight, ca. as long as calyx; throat appendages scaly, glabrous; lobes linear-obovate, 3.5–4.5 mm. Filaments filiform, ca. 2 mm; anthers linear-oblong, ca. 3 mm, 2-mucronulate at apex. Ovary 4-parted. Style 1.2–1.5 cm, usually slightly curved, base sparsely pubescent, capitate. Nutlets ca. 6 mm; basal disc triangular-ovate, ca. 5 mm, with reduced glochids and a prominent center line, margin and abaxially with dense glochids. Seeds yellowish brown, ovoid.

Meadows, forests, canyons; 1200–2800 m. C and W Gansu, Xinjiang, NW Xizang [Afghanistan, N India, Kashmir, Kazakhstan, Kyrgyzstan, Mongolia, Pakistan, Tajikistan, Turkmenistan, Uzbekistan].

1a. Nutlet margin with small glochids ..... 1a. subsp. *stylosa*

1b. Nutlet margin with dentate narrow wing ..... 1b. subsp. *pterocarpa*

#### 1a. *Lindelofia stylosa* subsp. *stylosa*

长柱琉璃草 (原变种) chang zhu liu li cao (yuan bian zhong)

*Cynoglossum stylosum* Karelin & Kirilov, Bull. Imp. Soc. Naturalistes Moscou 15: 409. 1842; *Lindelofia benthamii* J. D. Hooker; *Solenanthes nigricans* Schrenk ex Fischer & C. A. Meyer.

Nutlet margin with small glochids.

Meadows, forests, canyons; 1200–2800 m. C and W Gansu, Xinjiang, NW Xizang [Afghanistan, N India, Kashmir, Kazakhstan, Kyrgyzstan, Mongolia, Pakistan, Tajikistan, Turkmenistan, Uzbekistan].

1b. *Lindelofia stylosa* subsp. *pterocarpa* (Ruprecht) Kame- lin, Novon 3: 263. 1993.

翅果长柱琉璃草 chi guo chang zhu liu li cao

*Solenanthes nigricans* Schrenk var. *pterocarpus* Ruprecht, Mém. Acad. Imp. Sci. St. Pétersbourg, sér. 7, 14: 62. 1869.

Nutlet margin with a dentate narrow wing.

NW Xizang [Kyrgyzstan].

### 44. RINDERA Pallas, Reise Russ. Reich. 1: 486. 1771.

翅果草属 chi guo cao shu

Herbs perennial, erect, pubescent. Stems usually cespitose, branched or simple. Leaf blade entire. Cymes terminal, becoming corymbose or paniculate, ebracteate. Flowers pedicellate. Calyx 5-parted; lobes narrow, reflexed in fruit. Corolla tubular-campanulate; throat appendages lunate to ligulate, rarely wanting, sometimes a second whorl of appendages near middle or base of tube; lobes of limb 5, overlapping, vertical or divaricate, usually lanceolate, ca. as long as tube, rarely shorter. Stamens inserted below throat appendages of corolla tube; filaments filiform; anthers oblong to linear, partly or completely exerted, base hastate, apex obtuse, rarely acute. Ovary 4-parted. Style filiform, exerted, rarely included; stigma capitate. Gynobase fastigiate or subulate. Nutlets 4, orbicular or ovoid; abaxially concave, glabrous, margin with wide flat spreading wings, keeled along center line.

About 25 species: C Asia, Europe; one species in China.

1. *Rindera tetraspis* Pallas, Reise Russ. Reich. 1: 486. 1771.

翅果草 chi guo cao

*Cynoglossum laevigatum* Linnaeus f.; *Rindera laevigata* (Linnaeus f.) Roemer & Schultes.

Stems erect, single, 20–35 cm tall, glabrous or nearly so, striate-ribbed. Petiole of basal leaves long, ca. 8 cm; leaf blade oblong to lanceolate, 4–8 × 1.5–4 cm, usually glabrous, rarely sparsely villous, base cuneate, apex obtuse; stem leaves short petiolate or ± sessile, oblong to ovate, 2–5 cm, base rounded or subcordate. Inflorescences terminating stems and

branches, becoming widely spaced paniculate. Pedicel 3–5 mm, villous. Calyx 5–7 mm, slightly enlarged in fruit; lobes lanceolate, villous outside. Corolla 1.3–1.5 cm, glabrous; throat appendages minute or absent, lower appendages absent; lobes vertically spreading, lanceolate, somewhat shorter than tube. Filaments ca. 1 mm; anthers ca. 2 mm. Style exerted from corolla. Nutlets ovate-orbicular, ca. 1.5 cm in diam., wing entire or sometimes repand. Fl. Apr-May.

Rocky deserts, 500–600 m. Xinjiang (Burqin Xian) [Kazakhstan, Kyrgyzstan, Russia, Tajikistan, Turkmenistan, Uzbekistan].

## 45. SOLENANTHUS Ledebour, Pl. Icon. 8, t. 26. 1829.

长蕊琉璃草属 chang rui liu li cao shu

Herbs perennial, pilose or hispid. Leaves alternate, entire. Cymes densely flowered, or many cymes becoming paniculate, bracteate or ebracteate. Calyx 5-parted to base; lobes linear, lanceolate to oblong, scarcely enlarged. Corolla tubular, rarely campanulate, included or slightly surpassing calyx; appendages oblong, inserted at below middle of corolla tube; limb blue or purplish red; lobes 5, vertical or somewhat spreading. Stamens inserted above corolla appendages, exerted; anthers oblong to broadly elliptic, apex obtuse. Style usually exerted; stigma minute. Gynobase fastigiate. Nutlets dorsiventrally compressed, ovate to suborbicular, 5–10 mm, abaxially discoid, flat or slightly concave, with dense glochids on abaxial margin and adaxially; attachment scar above middle adaxially, occupying ca. 1/2 of surface, firmly coherent to gynobase.

About ten species: C and W Asia, SE Europe; two species in China.

- 1a. Basal leaf blades 5–8 × 3–6 cm; stem leaves several per inflorescence; corolla lobes much shorter than tube ..... 1. *S. circinnatus*  
1b. Basal leaf blades 1.6–2.3 × 1.1–1.4 cm; stem leaves 1 per inflorescence; corolla lobes longer than tube ..... 2. *S. hupehensis*

**1. *Solenanthus circinnatus*** Ledebour, Pl. Icon. 1: 8, t. 26. 1829.

长蕊琉璃草 chang rui liu li cao

*Solenanthus amplifolium* Boissier; *S. coronatus* Regel; *S. petiolaris* de Candolle; *S. rumicifolium* Boissier.

Roots stout, to 2 cm in diam. Stems erect, usually not branched, to 80 cm tall, base ca. 1 cm in diam., surrounded by persistent petioles, sparsely pubescent. Petiole of basal leaves 6–10 cm; leaf blade ovate-oblong, 5–8 × 3–6 cm, sparsely strigose, base cordate or subcordate, apex obtuse; stem leaves sessile, narrowly oblong to ovate, base attenuate, subdecurent. Cymes numerous, axillary, scorpioid, to 7 cm in fruit, becoming paniculate on upper part of stems, densely pubescent, ebracteate. Pedicel ca. 1.2 mm. Calyx 4.5–5.5 mm; lobes slightly spreading. Corolla purplish red, broadly tubular, ca. 6 mm, glabrous; appendages attached below middle of tube, ligulate; lobes of limb 5, toothlike, slightly 2-cleft. Stamens exerted; filaments somewhat unequal; anthers short oblong, ca. 1 mm. Style slightly curved, ca. 8 mm, exerted, glabrous, persistent. Nutlets ovoid, ca. 6 mm; disc slightly concave, tuberculate, marginal glochids confluent at base; attachment scar near apex adaxially, narrowly ovate, slightly concave. Fl. Apr-May, fr. Jun-Jul.

Meadows in forests. W Xinjiang [Afghanistan, Kazakhstan,

Kyrgyzstan, Pakistan, Russia, Tajikistan, Turkmenistan, Uzbekistan; SW Asia].

**2. *Solenanthus hupehensis*** R. R. Mill, Notes Roy. Bot. Gard. Edinburgh 44: 271. 1987.

湖北长蕊琉璃草 hu bei chang rui liu li cao

Herbs, to 5 cm high. Taproot slender, blackish. Petiole of basal leaves 2–4 cm, sparsely hispid; leaf blade 1.6–2.3 × 1.1–1.4 cm, densely strigose-pubescent, base shallowly cordate, apex short apiculate. Inflorescences 2–4, scapose with 1 leaf just below inflorescence, most parts pubescent. Cymes scorpioid, congested into dense head. Pedicel 4.5–6 mm. Calyx ca. 3.5 mm; lobes parted nearly to base, linear-lanceolate, ca. 0.8 mm wide. Corolla pale pink when dry, 4.5–5.5 mm; tube ca. 2 mm; throat scales ± square, ca. 0.3 × 0.3 mm, emarginate; lobes oblanceolate, 2.5–3.2 × ca. 1 mm, apex rounded. Stamens inserted just below throat, clearly exerted from corolla; filaments 3–3.5 mm; anthers ovoid, ca. 0.4 × 0.2 mm, medifixed. Styles ca. 6 mm, exerted beyond anthers.

- Ca. 600 m. Hubei (near Xueping Xian).

Fruiting material is needed to confirm the generic identity of *Solenanthus hupehensis*.

## 46. THYROCARPUS Hance, Ann. Sci. Nat. Bot., ser. 4. 18: 225. 1862.

盾果草属 *dun guo cao shu*

Herbs annual. Leaves alternate, sessile or short petiolate. Cymes bracteate. Calyx 5-parted to base, slightly enlarged in fruit. Corolla campanulate; throat appendages 5, broadly linear to subulate; limb 5-parted; lobes broadly ovate. Stamens inserted at middle of corolla tube, included; filaments short; anthers ovoid to oblong. Ovary 4-parted. Style included; stigma terete. Gynobase conical. Nutlets ovoid, slightly dorsiventrally compressed, densely tuberculate; disc margin 2-layered, inside layer membranous and entire, outside layer leathery and pectinate-dentate; attachment scar at apex adaxially. Seeds ovoid, dorsiventrally compressed.

About three species: China, Vietnam; two species in China.

- 1a. Stem leaves ovate to narrowly elliptic; corolla and calyx equal in length; teeth of outside layer of nutlet straight, not inflated at apex, inside layer not constricted inward ..... 1. *T. sampsonii*
- 1b. Stem leaves narrowly oblong to oblanceolate; corolla longer than calyx; anthers ovate-oblong; teeth of outside layer of nutlet distinctly inflated at apex and incurved, inside layer constricted inward ..... 2. *T. glochidiatus*

**1. *Thyrocarpus sampsonii*** Hance, Ann. Sci. Nat. Bot., ser. 4. 18: 225. 1862.

Hubei, Hunan, Jiangsu, Jiangxi, Shaanxi, Sichuan, Taiwan, Yunnan, Zhejiang [Vietnam].

盾果草 *dun guo cao*

*Bothriospermum majusculum* (Hayata) Suzuki; *B. tenellum* (Hornemann) Fischer & C. A. Meyer var. *majusculum* Hayata.

Stems single to several, erect to ascending, frequently branched below, 20–45 cm tall, spreading hirsute, minutely hispid. Basal leaves short petiolate, spatulate, 3.5–19 × 1–5 cm, hirsute, minutely hispid, hairs discoid at base, margin entire or sparsely serrulate; stem leaves sessile, narrowly oblong to oblanceolate, smaller. Cymes axillary or extra-axillary, 7–20 cm; bracts narrowly ovate to lanceolate. Pedicel 1.5–3 mm. Calyx ca. 3 mm; lobes narrowly elliptic, spreading minutely hispid outside, short appressed pubescent. Corolla light blue or white, longer than calyx; tube ca. 2/5 as long as limb; throat appendages linear, ca. 0.7 mm, fleshy, papillose, emarginate at apex; limb 5–6 mm wide; lobes spreading, suborbicular. Filaments ca. 0.3 mm; anthers ovate-oblong, ca. 0.5 mm. Nutlets 4, black-brown, ca. 2 mm, outside layer of disc margin pale, teeth straight and not inflated, inside layer margin not inwardly constricted. Fl. and fr. May-Jul.

Slopes, thickets. Anhui, Guangdong, Guangxi, Guizhou, Henan,

**2. *Thyrocarpus glochidiatus*** Maximowicz, Bull. Acad. Imp. Sci. Saint Pétersbourg 26: 499. 1880.

弯齿盾果草 *wan chi dun guo cao*

Stems single to several, slender, ascending or decumbent, frequently branched below, 10–30 cm tall, spreading hirsute and minutely hispid. Basal leaves short petiolate, spatulate to narrowly oblanceolate, 1.5–6.5 cm × 3–14 mm, hispid, hairs discoid at base; stem leaves sessile, ovate to narrowly elliptic, smaller. Cymes axillary or extra-axillary, to 15 cm; bracts ovate to lanceolate, 0.5–3 cm. Pedicel 1.5–4 mm. Calyx ca. 3 mm; lobes narrowly elliptic to ovate-lanceolate, pubescent, apex obtuse. Corolla light blue or white, ca. as long as calyx; tube ca. 2/3 as long as limb; throat appendages linear, ca. 1 mm, apex truncate or emarginate; limb ca. 2 mm wide; lobes slightly spreading, obovate to suborbicular. Anthers broadly ovate, ca. 0.4 mm. Nutlets 4, black-brown, ca. 2.5 mm, margin of outside layer of disc pale, teeth inflated at apex and incurved, margin of inside layer distinctly inwardly constricted. Fl. and fr. Apr-Jun.

• Meadows, field margins, roadsides. Anhui, Gansu, Guangdong, Henan, Jiangsu, Jiangxi, Shaanxi, N Sichuan.

**47. MATTIASTRUM** (Boissier) Brand, Repert. Spec. Nov. Regni Veg. 14: 150. 1915.

盘果草属 *pan guo cao shu*

*Paracaryum* Boissier Sect. *Mattiastrum* Boissier, Diagn. Pl. Orient. 2: 130. 1849.

Herbs perennial, biennial, or annual, usually pubescent. Cymes terminal or axillary, ebracteate. Calyx 5-parted nearly to base; lobes slightly enlarged in fruit. Corolla campanulate; throat 5-appendaged. Stamens inserted at middle of corolla, included. Ovary 4-parted. Style shortly terete, included; stigma entire. Gynobase narrowly terete. Nutlets broadly winged; attachment scar above middle adaxially, narrowly ovate.

About 30 species: mainly in SW Asia, extending into India and China; one species in China.

**1. *Mattiastrum himalayense*** (Klotzsch) Brand, Repert. Spec. Nov. Regni Veg. 14: 156. 1914.

盘果草 *pan guo cao*

*Mattia himalayensis* Klotzsch, Bot. Ergebn. Reise Waldemar 94, t. 64. 1862; *Paracaryum himalayense* (Klotzsch) C. B. Clarke.

Herbs annual, densely minutely hispid. Stems erect, usually branched, 20–30 cm tall. Basal leaves oblong-oblongate to spatulate, 5–9 × 0.5–1.5 cm, pubescent, base attenuate, margin entire, apex obtuse; stem leaves sessile, smaller. Inflorescences terminal and axillary, elongated in fruit. Flowers subsessile. Calyx lobes elliptic, ca. 2.5 mm, slightly fleshy, exterior and margin pubescent. Corolla pale yellow-white; tube ca. as long as calyx; throat appendages ±

trapeziform; limb somewhat shorter than tube; lobes suborbicular, ca. 1.5 mm wide. Anthers oblong, ca. 0.9 mm. Ovary lobes 1–3 developed. Style ca. 0.9 mm; stigma obscure. Nutlets suborbicular-ovate, ca. 7 mm, winged, with sparse short glochids, marginal wing ca. 0.8 mm wide.

Gravelly slopes. W Xizang [Afghanistan, NW India, Kashmir, Pakistan].