Lepidostemon (Brassicaceae) is No Longer Monotypic

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ABSTRACT. Previously monotypic *Lepidostemon* is expanded to include five species, of which *L. everestianus* and *L. gouldii* are herein described as new. The new combinations *L. rosularis* and *L. glaricola* are proposed. The genus is reported for the first time from China. *Chrysobraya* is reduced to synonymy of *Lepidostemon*.

Lepidostemon has been recognized as monotypic since the original description of *L. pedunculosus* J. D. Hooker & Thomson as the generic type (Hooker & Thomson, 1861). Except for the treatments by Hayek (1911) and Schulz (1936), the genus was never studied in context with other Himalayan genera in Brassicaceae (Cruciferae). As shown below, of the five species of *Lepidostemon*, one was described in the monotypic genus *Chrysobraya* H. Hara (as *C. glaricola* H. Hara) and another in *Christolea* Cambessèdes (as *C. rosularis* K. C. Kuan & Z. X. An). However, neither of these two species was compared with *L. pedunculosus*.

In his original description of *Chrysobraya*, Hara (1974) indicated that the genus is most closely allied to *Braya* Sternberg & Hoppe and listed several similarities, including aspects of their nectar glands, cotyledonary position, ebracteate racemes, and branched trichomes. Although the trichomes in *Chrysobraya* are branched, they are almost exclusively dendritic, whereas in *Braya* these trichomes are simple and unbranched, and are only forked. Furthermore, the persistence of all floral parts well after fruit dehiscence in *Chrysobraya* in contrast to their abscission immediately after anthesis in *Braya* does not support any close affiliation. *Chrysobraya* is morphologically similar to *Lepidostemon*, with which it shares trichome aspect, persistent floral parts, toothed nectaries, coarsely toothed leaves, yellow petals, and solitary early flowers. However, *Chrysobraya* differs from *Lepidostemon* in having cotyledons incumbent instead of accumbent and staminal filaments toothless and wingless instead of winged and toothed. Several genera of the Brassicaceae (e.g., *Alyssum* L., *Dontostemon* Andrzejowski ex C. A. Meyer) include species with both toothed or toothless and winged or wingless staminal filaments (Al-Shehbaz, 1987; Al-Shehbaz & Ohba, 2000), and the cotyledonary position has often been shown to be an unreliable generic character. Therefore, *Chrysobraya* is reduced to synonymy of *Lepidostemon*.

As delimited herein, *Lepidostemon* consists of five, exclusively Himalayan species distributed in Bhutan, China (Xizang), Nepal, and Sikkim. It is characterized by having branched trichomes sometimes mixed with simple ones (but at least some are dendritic), floral parts (sepals, petals, and stamens) persisting well after fruit maturity, winged and often toothed median staminal filaments, as well as linear or linear-oblong, often torulose fruits. It should be noted that one species, *L. glaricola*, has slender, toothless filaments, and another, *L. gouldii*, has floral parts that fall off shortly after anthesis. However, these two species show such remarkable morphological similarities in other characters to *L. pedunculosus* that they may reliably be included in *Lepidostemon*. From both *Streptoloma* Bunge (2 species, central Asia) and *Braya*, *Lepidostemon* is readily distinguished by having toothed and/or winged median staminal filaments, persistent floral parts, and often some dendritic trichomes. Both *Braya* and *Streptoloma* have wingless and toothless median staminal filaments, readily deciduous floral parts, and no dendritic trichomes. *Braya* has simple and/or forked stalked trichomes, whereas *Streptoloma* has almost exclusively malpighiaceous ones.

Lepidostemon J. D. Hooker & Thomson, J. Linn. Soc., Bot. 5: 131. 1861. TYPE: *Lepidostemon pedunculosus* J. D. Hooker & Thomson.

Chrysobraya H. Hara, J. Jap. Bot. 49: 193. 1974. TYPE: *Chrysobraya glaricola* H. Hara.

Herbs annual or caespitose perennial. Trichomes dendritic, forked and stalked, submalpighiaceous, or simple, often more than one kind present. Stems erect, simple from rosettes, leafy or leafless. Basal leaves petiolate, rosulate, simple, entire or dentate. Cauline leaves similar to basal, sometimes pinnatifid, rarely absent. Racemes few to many flowered, ebracteate or rarely bracteate throughout, elongated or not elongated in fruit, sometimes flowers solitary on long pedicels originating from axils of rosette leaves. Fruiting pedicels slender, divaricate or recurved. Sepals oblong, persistent or rarely cadu-

cous, base not saccate, margin membranous. Petals yellow, white, lavender, or purple; blade broadly obovate or rarely spatulate, apex rounded or emarginate; claws subequaling sepals. Stamens 6, tetradynamous; filaments winged or rarely wingless, toothed or rarely toothless; anthers reniform or rarely oblong, not apiculate at apex. Nectar glands 4, lateral; median nectaries absent. Ovules 8 to 28 per ovary. Fruit dehiscent siliques, linear-oblong to linear, terete or latiseptate, sessile; valves papery, obscurely veined, rarely marginal veins prominent, pubescent, torulose or rarely smooth; replum rounded, visible; septum complete or rarely perforated, membranous; style distinct, to 2 mm long; stigma capitate, entire or rarely slightly 2-lobed. Seeds uniseriate, wingless, oblong or ovate, plump; seed coat minutely reticulate, not mucilaginous when wetted; cotyledons accumbent or rarely incumbent.

Five species: Bhutan, China (Xizang), Sikkim, and Nepal.

KEY TO THE SPECIES OF *LEPIDOSTEMON*

1a. Racemes bracteate throughout; leaf trichomes almost exclusively simple; anthers oblong, 0.7–0.9 mm long . . . . . 3. *L. everestianus*

1b. Racemes ebracteate, rarely lowermost few flowers bracteate, leaf trichomes dendritic, submalpighiaceous, forked or simple; anthers reniform, 0.3–0.5(–0.6) mm long.

2a. Perennials; trichomes crisped, almost exclusively dendritic; filaments slender; nectar glands clavate, 0.5–1 mm long; cotyledons incumbent; petals bright yellow; stems leafless . . . . . 5. *L. glaricola*

2b. Annuals; trichomes not crisped, simple, forked, dendritic, or submalpighiaceous, often a mixture of more than one type; filaments flattened; nectar glands ovate, 0.1–0.3(–0.4) mm long; petals purple, lavender, white, or light yellow; cotyledons accumbent (unknown in *L. gouldii*); stems leafy.

3a. Fruit strongly flattened, not torulose, 2.5–3 mm wide; valve margin thickened, with prominent marginal veins; median filaments toothless; seeds ovate . . . . . 4. *L. rosularis*

3b. Fruit terete, torulose, ca. 1 mm wide; valve margin not thickened, with obscure marginal veins; median filaments toothed; seeds oblong.

4a. Petals purple to lavender, rarely white; sepals, petals, and stamens deciduous shortly after flowering and before fruit maturity; racemes elongated in fruit; fruiting pedicels recurved; leaf trichomes predominantly simple; fruit with stalked forked and dendritic trichomes . . . . . 2. *L. gouldii*

4b. Petals yellow; sepals, petals, and stamens persistent well after fruit maturity; racemes not elongated in fruit; fruiting pedicels straight; leaf trichomes primarily dendritic and submalpighiaceous; fruit with submalpighiaceous sessile trichomes . . . . . 1. *L. pedunculosus*

1. Lepidostemon pedunculosus J. D. Hooker & Thomson, J. Linn. Soc., Bot. 5: 156. 1861. TYPE: Sikkim. Alt. 14,000–16,000 ft., *J. D. Hooker s.n.* (holotype, K; isotypes, BM, G, GH, P).

Herbs annual, 2–10 cm tall. Trichomes short stalked and subdendritic or forked, subsessile and submalpighiaceous and dendritic on leaves, stems, pedicels, and fruits, rarely simple along leaf margin. Basal leaves rosulate, smaller than and somewhat similar to cauline ones, drying by flowering time. Stem leaves few to many, often densely grouped below inflorescence; petioles 3–10(–25) mm long, ciliate with simple subsetose trichomes; leaf blades spatulate to oblanceolate, 3–12 × 2–7 mm, base attenuate, margins dentate to pinnatifid with 1 to 4, oblong to linear, 1–5 × 0.5–1 mm, lateral lobes on each side, apex obtuse. Racemes 8- to many flowered, ebracteate or sometimes lowermost pedicels with adnate bracts, not elongated in fruit. Fruiting pedicels divaricate, straight, 1–3.5 cm long. Sepals oblong, 2–3.5 × 1–1.5 mm, spreading, sparsely hairy, persistent. Petals yellow, broadly obovate to spatulate, 3–5.5 × 1.5–4 mm, persistent, apex emarginate to rounded; claws 1–2 mm long. Filaments 2–3 mm long, persistent; median pairs with oblong to obovate wings 0.5–0.9 mm wide, unexpanded portion of filament to 0.6 mm long; lateral pair entire or winged; anthers reniform, 0.3–0.5 mm long. Nectar glands ovate, to 0.2 mm long. Ovules 6 to 14 per locule. Fruit narrowly linear, 1.5–2.5 cm × ca. 1 mm, terete; valves torulose, densely beset with submalpighiaceous sessile trichomes; septum complete; style 0.5–2 mm long; stigma ca. as wide as style, entire. Seeds oblong, 1–1.4 × 0.5–0.6 mm; cotyledons accumbent.

Phenology. Flowering in June and July; fruiting in July and August.

Habitat. Rocky slopes; elevation 4200–4900 m.

Distribution. China and Sikkim.

The material from China has somewhat larger flowers than that of the Sikkim type and perhaps represents an undescribed infraspecific taxon. However, I have examined only a limited collection of the species from its entire range and therefore refrain from recognizing the Chinese material formally.

Although the type of *Lepidostemon pedunculosus* was collected from Sikkim (Hooker & Thomson, 1861), the species was not included in recent floristic works of India (Hajra & Chowdhery, 1993; Srivastava, 1998). The report of the species from Bhutan and the description of flower color as purple (Grierson, 1984) is based on plants herein recognized as *L. gouldii.*

Specimens examined. CHINA. **Xizang (Tibet):** Tremo La, *Gould 2381* (K); Guatoa to Phari via Dotha Valley, *Gould 2132* (K); Choom-la-ru, 30 July 1882, *King s.n.* (BM, K).

2. Lepidostemon gouldii Al-Shehbaz, sp. nov. TYPE: Bhutan. Kemphu, 12,000–16,000 ft., 13 June 1938, *J. Gould 466* (holotype, BM; isotype, BM).

Herba annua. Folia caulina spathulata vel oblanceolata, integra vel 1- vel 2-dentata, pilis simplicibus. Racemi ebracteati, 3- ad 12-flori. Sepala, petala et filamenta caduca. Petala purpurea, lavandula, vel alba, 4.5–6 × 3–4 mm. Filamenta mediana dentata, alata, 1.5–2.5 mm longa; alae 0.3–0.5 mm latae. Siliquae immaturae anguste oblongae, 5–10 mm longae; valvae torulosae, pilis furcatibus et dendroidibus.

Herbs annual, 2–15 cm tall. Trichomes simple, stalked forked (Y-shaped), or subsessile and submalpighiaceous on stems and pedicels, predominantly simple and to 1.5 mm long on leaves. Basal leaves rosulate, smaller than and somewhat similar to cauline ones, drying by flowering time. Stem leaves few to many, well-spaced below the inflorescence; petioles obsolete or rarely to 2 mm long; leaf blades spatulate to oblanceolate, 2–15 × 1–3(–4) mm, sparsely pubescent, base attenuate, margins entire or obscurely dentate with 1 or 2 teeth on each side, apex obtuse. Racemes 3- to 12-flowered, ebracteate, elongated considerably in fruit. Fruiting pedicels divaricate, recurved, 5–12 mm long. Sepals oblong, 1.5–2 × 1–1.5 mm, spreading, caducous. Petals purple to lavender or rarely white, broadly obovate, 4.5–6 × 3–4 mm, caducous, apex emarginate; claws 1–2 mm long. Filaments 1.5–2.5 mm long, caducous; median pairs dentate, with a linear wing 0.3–0.5 mm wide, unexpanded portion of filament to 0.3 mm long; lateral pair entire; anthers reniform, 0.3–0.5 mm long. Nectar glands ovate, 0.2–0.3(–0.4) mm long. Fruit (immature) narrowly oblong, 5–10 × ca. 1 mm, terete; valves torulose, densely pubescent with stalked, forked and dendritic trichomes; style ca. 1 mm long; stigma large, wider than style, entire. Immature seeds oblong.

Phenology. Flowering May to July; fruiting July to August.

Habitat. Sandy soil near streams, moist *Abies* forest; elevation 3600–4900 m.

Distribution. Bhutan and Nepal.

One of the paratypes, *Ludlow & Sherriff 16839* (BM), was cited by Hara (1977) as a paratype of *Draba williamsii* H. Hara. However, plants of this collection have ebracteate racemes and toothed median staminal filaments that support its placement in *Lepidostemon.* By contrast, the type collection and all Nepalese paratypes of *D. williamsii* cited by Hara have toothless filaments and racemes bracteate throughout.

The single collection cited below from Nepal was annotated as *Lepidostemon pedunculosus,* but that species is restricted to China and Sikkim. *Lepidostemon gouldii* is readily distinguished from *L. pedunculosus* by the flower color, leaf and fruit trichomes, curvature of fruiting pedicels, and duration of floral parts (see key).

Paratypes. BHUTAN. Kemphu, *Gould 465* (BM, E), *Gould 467* (BM); Saga La, upper Mangde Chu, *Ludlow & Sherriff 16839* (BM); Upper Bumthang Chu District, Lambrang Chu, *Lyon 10129* (E); Bumthang District, Dhur Chu, *Lyon 10113* (E). NEPAL. Dolpa District: W of Ringmo, *Yoshida 1007* (TI).

3. Lepidostemon everestianus Al-Shehbaz, sp. nov. TYPE: [China. Xizang] Tibet. East Rongbuk Glacier, Mt. Everest, 21,000 ft. [ca. 6400 m], big scree, 26 July 1935, *E. E. Shipton s.n.* (holotype, BM).

Herba perennis, pilis primariis simplicibus. Folia basalia ovata vel oblonga, 2–6 × 1–3 mm, integra. Racemi 6- ad 12-flori, bracteati; bracteae et pedicelli adnati. Sepala, petala, et filamenta persistentia. Petala alba, obovata, ca. 5 × 2.5 mm. Filamenta mediana dentata et alata, ca. 3.5 mm longa; alae ca. 0.5 mm latae. Siliquae oblongolineares, ca. 7 × 1.5 mm, torulosae. Semina ovata, ca. 1.4 mm longa.

Herbs perennial, 3–4 cm tall, pilose, with a slender rhizome-like caudex. Trichomes almost exclusively simple, to 1 mm long, rarely a few forked and dendritic ones present. Basal leaves rosulate, persistent; petioles 0.5–4 mm long; leaf blades ovate to oblong, 2–6 × 1–3 mm, densely pilose, base obtuse, margins entire, apex obtuse. Stem leaves and bracts similar to basal leaves but smaller. Racemes 6- to 12-flowered, bracteate throughout, slightly elongated in fruit; bracts adnate to pedicels. Fruiting pedicels ascending-divaricate, straight, 2–3 mm long. Sepals oblong, ca. 3 × 1 mm, spreading, sparsely hairy, persistent. Petals white, obovate, ca. 5 × 2.5 mm, apex rounded; claws 2–3 mm long. Filaments persistent; median pairs ca. 3.5 mm long, winged and ca. 0.5 mm wide

basally, minutely toothed below middle; lateral pair ca. 3 mm long, slender, wingless; anthers oblong, 0.7–0.9 mm long. Ovules ca. 4 per locule. Fruit oblong-linear, ca. 7 × 1.5 mm, terete; valves torulose, densely pubescent, obscurely veined; septum complete; style ca. 0.7 mm long; stigma minute, entire. Seeds ovate, ca. 1.4 mm long; cotyledons accumbent.

Phenology. Flowering and fruiting in July.
Habitat. Scree; elevation 6400 m.
Distribution. Endemic to China (Xizang).

Lepidostemon everestianus grows at an altitude (ca. 6400 m) that surpasses every other Brassicaceae that I know. Unfortunately, the species is known only from the type gathering, and more collections are needed to have a better understanding of this remarkable species.

Lepidostemon everestianus differs from the rest of the genus in having almost exclusively simple leaf trichomes and fully bracteate inflorescences. However, it is assigned to *Lepidostemon* by its dentate, winged filaments of the median stamens, persistent sepals, petals, and stamens, and toothlike lateral nectaries.

4. **Lepidostemon rosularis** (K. C. Kuan & Z. X. An) Al-Shehbaz, comb. nov. Basionym: *Christolea rosularis* K. C. Kuan & Z. X. An, in C. Y. Wu, Fl. Xizangica 2: 386. 1985. TYPE: China. Xizang: from Ritang to Cona, 4750 m, 21 Aug. 1975, *Qinghai-Xizang Expedition 75–1490* (holotype, PE; isotype, KUN).

Herbs annual, 1–4 cm tall. Trichomes short stalked and subdendritic or forked, simple ones to 1 mm long on petioles and fruits. Basal leaves rosulate, smaller than cauline ones, entire, drying by flowering time. Stem leaves several to many, often densely grouped below inflorescence; petioles 5–14 mm long, ciliate with simple trichomes; leaf blades spatulate to oblanceolate or ovate, 3–10 × 2–6 mm, sparsely pubescent, base cuneate, margins with 1 to 4 teeth on each side, apex obtuse. Racemes 10- to many flowered, ebracteate or rarely lowermost pedicels with adnate bracts, not elongated in fruit. Fruiting pedicels divaricate, straight, 0.5–2 cm long. Sepals oblong, 2–3.5 × 1–1.5 mm, spreading, pubescent, persistent. Petals white, broadly obovate, 3–5 × 2–3 mm, persistent, apex rounded; claws 1–2 mm long. Filaments 2–2.5 mm long, persistent; median pairs narrowly lanceolate, winged, 0.4–0.5 mm wide; lateral pair slender, wingless; anthers reniform, 0.4–0.5 mm long. Ovules 6 to 8 per locule. Fruit oblong-linear, 1–2 cm × 2.5–3 mm, flattened; valves with obscure midvein and prominent marginal veins, somewhat indurate at margin and connate at base, dehiscing basipetally, not torulose, pilose with forked and/or simple trichomes; septum complete; style 0.5–1.5 mm long; stigma subentire to 2-lobed. Seeds ovate, 1.2–1.6 × 0.8–1 mm; cotyledons accumbent.

Phenology. Flowering June and July; fruiting July and August.
Habitat. Stony ground, slopes, dry gullies, scree; elevation 4200–5100 m.
Distribution. Endemic to China.

The type collection (three sheets) of *Lepidostemon rosularis* consists of five plants with mature fruits and a few aborted flowers, while *Kingdon-Ward 11846* consists of eight plants all in flower and some with young fruits. The two collections are basically similar except for the fruit indumentum. Fruits of the type collection are covered exclusively with simple trichomes, whereas those of Kingdon-Ward's collection have simple trichomes on the valve margin and either exclusively forked or a mixture of simple and forked on the rest of the valve.

The holotype of *Lepidostemon rosularis* has some pedicels with small adnate bracts. In this, the species resembles *L. pedunculosus* and *L. everestianus*, though the last has all pedicels with adnate bracts.

In assigning this species to *Christolea*, Kuan (1985) and An (1987) followed Jafri (1955, 1973) who adopted a very broad concept of the genus that included species presently assigned to six genera (Al-Shehbaz, 2000). It is excluded from *Christolea* because it is an annual with a distinct basal rosette, leafless stems, branched trichomes, accumbent cotyledons, obtuse anthers, winged filaments of median stamens, and persistent floral parts. *Christolea* consists of perennials without basal rosettes and with leafy stems, simple trichomes, incumbent cotyledons, apiculate anthers, slender filaments, and deciduous floral parts. Although most species of *Christolea* recognized by Kuan (1985), An (1987), and Jafri (1955, 1973) have been assigned to *Desideria* (Al-Shehbaz, 2000), *Lepidostemon rosularis* clearly differs from those by having a distinct style, fruit valves not adnate apically to the replum, white flowers, persistent floral parts, winged filaments, and pinnately veined leaves. By contrast, species of *Desideria* have obsolete styles, fruit valves adnate apically to the replum, blue or purplish flowers, deciduous floral parts (sometimes sepals persistent), wingless filaments, and palmately veined leaves. Except for its flattened fruits with thickened valve margins, *L. rosularis* is perfectly at home in *Lepidostemon*.

Other material examined. CHINA. **Xizang (Tibet):** Sanga Chöling, *Kingdon-Ward 11846* (BM).

5. Lepidostemon glaricola (H. Hara) Al-Shehbaz, comb. nov. Basionym: *Chrysobraya glaricola* H. Hara, J. Jap. Bot. 49: 195. 1974. TYPE: Bhutan. Above Kuma Thang, Paro Chu Drainage, in moss or scree with running water, 13,000 ft., 14 Oct. 1949, *Ludlow & Sherriff 17477* (holotype, BM).

Herbs caespitose perennials, 1–10 cm tall. Trichomes crisped, dendritic, or rarely forked. Basal leaves rosulate, many; petioles 3–12 mm long; leaf blades spatulate to obovate or oblanceolate, 3–15 × 1.5–5 mm, base attenuate, margins 1- to 4-toothed on each side, rarely subentire, apex subacute to obtuse. Racemes many flowered, ebracteate, elongated in fruit. Fruiting pedicels ascending to divaricate, slender, straight or slightly curved, (0.5–)1–3 cm long. Sepals oblong, 2–2.5 × 1–1.5 mm, slightly spreading, hairy, persistent. Petals bright yellow, broadly obovate, 3–6 × 2–4 mm, persistent, apex emarginate to rounded; claws 1–2 mm long. Filaments 1.5–2.5 mm long, persistent, neither winged nor dentate; anthers reniform, 0.5–0.6 mm long. Nectar glands clavate, 0.5–1 mm long. Ovules 4 to 6 per locule. Fruit linear-oblong, 4–11 × 1.5–2 mm, terete; valves torulose, densely pubescent with dendritic trichomes, obscurely veined; septum complete or perforate; style 0.3–1 mm long; stigma wider than style, entire. Seeds oblong, 1–1.2 × 0.5–0.6 mm; cotyledons incumbent.

Phenology. Flowering May through July; fruiting July to October.

Habitat. On rocks, in mossy boulder scree, wet stream beds, scree with running water, meadows, rock crevices; elevation 4000–4700 m.

Distribution. Bhutan and Nepal.

Lepidostemon glaricola is much more common in Bhutan than in Nepal, and the record from Nepal is based on the single collection below, which was reported by Hara (1974, 1979) under *Chrysobraya.*

Specimens examined: BHUTAN. Saga La, Upper Mangde Chu, *Ludlow, Sherriff & Hicks 16838* (E); Marlung, Tsampa, *Ludlow, Sherriff & Hicks 19376* (E); Kuma Thang, foot of Pangte La, Paro Chu, *Ludlow & Sherriff 16276* (BM, E); Pangte La, Paru Chu, *Ludlow & Sherriff 16290* (BM, E); Lingshi, *Cooper 1654* (E); Dole La, *Cooper 4037* (E); Yelé La Timpu, *Cooper 1851* (E); Upper Mo Chu District, valley below Chhew La, above Chebesa, 27°57′N, 89°29′E, *Sinclair & Long 5444* (E); Yala, Pyala, *Gould 1316* (K). NEPAL. Jalang Chhyongo, *Kanai, Ohashi, K. Iwatsuki, Ohba, Z. Iwatsuki & Shakya 720631* (TI).

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