

ERIOCAULACEAE

J.P.C. Tan

Martinov, *Tekhnobot. Slovar* (1820) 237, as ‘Eriocaulaceae’, nom. cons., validated by reference to Richard, *Ann. Mus. Hist. Nat.* 17 (1811) 465, as ‘Eriocaulées’, nom. inval.; Kunth in Humboldt et al., *Nov. Gen. Sp.* 1 (1816 [‘1815’]) 251, as ‘Restiaceae, section Eriocaulaceae’; Desvaux, *Ann. Sci. Nat.* (Paris) 13 (1828) 45, as ‘Eriocaulonées’; Körnicke, *Linnaea* 27 (1854) 564; Ruhland in Engler, *Pflanzenr.*, IV, fam. 30 (Heft 13) (1903) 1; Hooker, *Fl. Brit. India* 6, fasc. 19 (1893) 571; Ridley, *Mat. Fl. Malay. Penins.* 3 (1907) 53, as ‘Eriocauloneae’; Ridley, *Fl. Malay Penins.* 5 (1925) 133; Henderson, *Malay. Wild Fls., Monocot.* (1954) 212; Van Royen, *Nova Guinea, new ser.*, 10 (1959) 21; Hutchinson, *Fam. Fl. Pl., Monocot.*, ed. 2 (1959) 574; Cook in Heywood (ed.), *Fl. Pl. World* (1978, reprint 1985) 281; Faden in Dahlgren et al., *Fam. Monocot.* (1985) 395; Stützel in Kubitzki (ed.), *Fam. Gen. Vasc. Pl.* 4 (1998) 197; Mabberley, *Mabberley’s Pl. Book*, ed. 3 (2008) 314; Prajaksood et al., *Fl. Thailand* 13(3) (2017) 434.
Type: *Eriocaulon* L.

Perennial or short-lived herbs, monoecious, helophyte or terrestrial or facultatively aquatic, rarely floating in water bodies; stem short, tufted, some species with elongated or branched rhizome above ground. **Leaves** rosulate or spirally arranged along a stem; lamina simple, linear, narrow or grass-like, flat, filiform, tip pointed. **Inflorescences** a capitulum on each thin scape, solitary or clustered in an umbel, usually monoecious, male and female flowers attached to central receptacle, peduncle each with a sheathing leaf at the base. **Involucral bracts** in several outermost whorls, rigid or thin papery, hairy or glabrous. **Floral bracts** throughout capitulum in many overlapping whorls, rigid or thin papery, with or without various types and density of hairs. **Flowers** numerous, small, unisexual, subactinomorphic to zygomorphic, each enclosed by an incurving floral bract. **Sepals** free or partially connate at base. **Petals** usually free, glabrous or hairy, sometimes with nectar-gland near to apex, obtuse or acute. **Male flowers** with stamens and petals fused together at base to form a stalk, sometimes with a vestigial gynoeceum at centre, anthers usually brown to black, rarely white. **Female flowers** with a superior ovary surrounded by a perianth, ovary 2 to 6-locular, style with several branches and long stigmas. **Fruits** small, loculicidally dehiscent, each locule containing a single seed. **Seeds** ellipsoid, surface smooth or with ribbon-like or pillar-like epidermal cells.

Distribution. Eriocaulaceae is a family of 10 genera and c. 1400 species, mainly distributed in the tropics and subtropics, but also with a few species extending into temperate regions in Western Europe and North America. The highest diversity of Eriocaulaceae is in South America, especially in Brazil which has c. 630 species. Nine genera are confined to the Americas and Africa, several of which are narrowly distributed. *Actinocephalus* (Körn.) Sano, *Comanthera* L.B.Sm., *Leiothrix* Ruhland and *Rondonanthus* Herzog are restricted to South America; *Paepalanthus* Mart. and *Syngonanthus* Ruhland occur in Central and South America, Africa and Madagascar; *Tonina* Aubl., a monotypic genus, occurs in Central America and the north of South America; *Lachnocaulon* Kunth is restricted to North America; and *Mesanthemum* Körn.

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occurs in Africa and Madagascar. *Eriocaulon* occurs on all continents and is also the only genus in Asia. In Singapore there are 2 species, one of which has two varieties.

Ecology. Most genera occur in open and poorly drained areas, humid grasslands, seasonal pools, margins of lakes or streams, and in disturbed open areas that are consistently wet, e.g. rice fields, on muddy, sandy, nutrient poor soils, and on sandstone boulders. The roots and basal leaf sheath are often submerged in shallow water, while the leaves and inflorescence are raised above the water surface. Some species may be fully submerged. Environmental factors, especially water level, light exposure and the substrate, can lead to distinctive vegetative variation. For example, individuals with wet and submerged basal parts tend to have significantly longer leaves with spongy air-spaces and a longer scape, compared to individuals rooted in a damp but not submerged medium. In Singapore they can be found at the margins of reservoirs, shallow pools, garden ponds, and drains. They occur in localities such as MacRitchie Reservoir, Nee Soon, Upper Peirce Reservoir and Singapore Botanic Gardens. Pollination in Japanese species of *Eriocaulon*, and in Brazilian *Comanthera* and *Syngonanthus*, is reported to be by insects from the orders Diptera, Hymenoptera and Coleoptera (Tanaka et al., Bull. Natl. Mus. Nat. Sci., Ser. B 4 (2015) 179–182; Ramos et al., Ann. Bot. (Oxford) 96 (2005) 387–397).

Uses. Many species of *Eriocaulon*, such as *E. cinereum* R.Br. and *E. setaceum* L., are cultivated as aquarium ornamental plants. Others have also been commercialised as potted ornamental plants, e.g. *Syngonanthus chrysanthus* (Bong.) Ruhland, for their shining golden pin-headed inflorescences. The shining golden scapes of *Syngonanthus nitens* (Bong.) Ruhland are harvested by villagers in Jalapão region, Tocantins state, Brazil to make exquisite handicrafts such as hats, handbags and accessories for the local and international fashion market. Inflorescences of *Syngonanthus*, *Comanthera* and *Paepalanthus* species are also dried and dyed in a myriad of colours for floral arrangement and craftwork. The Chinese Pharmacopoeia Commission (Pharmacopoeia of the People’s Republic of China (2010) 168) and Qiao et al. (J. Pharm. Biomed. Analysis (2012) 133) report that *Eriocaulon buergerianum* Körn. is used in traditional Chinese Medicine to treat ophthalmic disorders, as an anti-inflammatory, and as an antimicrobial agent.

Taxonomy. Ruhland (in Engler, Pflanzenr., IV, fam. 30 (Heft 13) (1903) 1–294) did a full revision of Eriocaulaceae and recognised two subfamilies: Eriocauloideae and Paepalanthoideae, based on floral characters. Molecular phylogenetic studies (e.g. Andrade et al., Taxon 59 (2010) 379–388; Giulietti et al., Rodriguésia 63 (2012) 1–19) support the monophyly of both subfamilies and the recognition of the ten genera currently recognised within Eriocaulaceae. All of the Asian species belong to *Eriocaulon* subfamily Eriocauloideae.

ERIOCAULON L.

(Greek, *erio-* = woolly, Latin, *-caulon* = stalk or stem;
referring to the woolly stalks of some species)

Pipewort (English)

Sp. Pl. 1 (1753) 87; Kunth in Humboldt et al., Nov. Gen. Sp. 1 (1816 [‘1815’]) 251; Desvaux, Ann. Sci. Nat. (Paris) 13 (1828) 47; Martius in Wallich, Pl. Asiat. Rar. 3(10) (1832) 27; Körnicke, Linnaea 27 (1854) 577; Hooker, Fl. Brit. India 6, fasc. 19 (1893) 571; Ruhland in Engler, Pflanzenr., IV, fam. 30 (Heft 13) (1903) 30; Ridley, Fl. Malay Penins. 5 (1925) 133; Van Royen, Nova Guinea, new ser., 10 (1959) 22; Faden in Dahlgren et al., Fam. Monocot. (1985) 397; Phillips, Rev. Handb. Fl. Ceylon 11 (1997) 48; Stützel in Kubitzki (ed.), Fam. Gen. Vasc. Pl. 4 (1998) 204; Mabberley, Mabberley’s Pl. Book, ed. 3 (2008) 315; Prajaksood et al., Fl. Thailand 13(3) (2017) 435. **Type:** *Eriocaulon decangulare* L.

Annual or short-lived herb; aquatic or terrestrial, usually tufted; most species have a short stem as a basal disc. **Leaves** crowded into a rosette; lamina erect, arching or reclinate, linear or grass-like, apex acute or attenuate, margins entire, surface flat, curved inwards or undulate. **Scapes** solitary, erect, single capitulum on ribbed and thin peduncle, glabrous or hairy, tubular sheathing leaf at the base. **Capitulum** globose, broadly ovoid, oblate or hemispherical, yellowish white to dark brown; bisexual, male and female flowers in separate whorls or intermixed. **Involucral bracts** in 1–3 outermost whorls, ascending, spreading or recurved, elliptic, obovate or oblanceolate, apex rounded, obtuse or acute, rigid or thin papery, hairy or glabrous. **Floral bracts** ascending, recurved or radiating in all directions, often shallowly concave, obovate, oblanceolate or spatulate, apex acute to long-acuminate, hairy or glabrous. **Flowers** pedicellate or sessile, attached to central receptacle, 2- or 3-merous. **Sepals** free, curved or fused into spathe-like structure, apex acute or bilobed, fringed with white-villous hairs. **Petals** free, glabrous or with hair at margins, sometimes also on adaxial and abaxial surfaces, white-villous hairs at apex, sometimes with a black nectar-gland near to apex, petals in male flowers arranged in a whorl on top of elongated stipe. **Male flowers** with 5–6 fertile stamens, bi- or tetra-sporangiate anthers, each basifixed to filament, longitudinally dehiscent, usually brown to black, during anthesis stamens exerted or not beyond floral bracts. **Female flowers** with superior ovary, 2–6-locular, style rather short with 2–6 longer stigmas, stigma often elongated beyond floral bracts. **Fruit** a very thin-layered capsule, 2–6 seeds per fruit. **Seeds** ellipsoid, yellow to dull orange-red, seed coat smooth or with ribbon-like or pillar-like epidermal cells.

Distribution. Worldwide but mainly in tropical and subtropical regions. In Singapore 2 native species, one of which has 2 varieties.

Ecology. *Eriocaulon* species in Singapore thrive in fully exposed wetland habitats, such as the edges of lakes and streams, waterlogged shallow pools, and drains with stagnant water. There are also several species restricted to damp rock crevices at higher altitudes in other parts of Southeast Asia.

Taxonomy. *Eriocaulon* is a well-supported monophyletic genus within the Eriocaulaceae (Andrade et al., Taxon 59 (2010) 379–388). It is a rather large genus with c. 500 species, including over 30 species described in the last two decades. Previous subgeneric classifications using morphological characters have resulted in groups that are difficult to distinguish when considered over the geographical range of the genus. Further molecular analyses covering the geographical and morphological variation in the genus are required.

Notes. The genus description applies to species found in Singapore and Peninsular Malaysia.

Key to *Eriocaulon* species

1. Base of each scape in tube-like sheath with apex of sheath spathe-like; whorl of involucre bracts as wide as diameter of capitulum, elliptic to obovate, scarious; floral bracts sparsely covered with white papillate hairs **1. *E. truncatum***
 Base of each scape encircled by a leaf-like sheath with apex tightly inrolled into rigid linear structure; whorl of involucre bracts smaller than diameter of capitulum, broadly obovate, rigid; floral bracts densely covered with white papillate hairs
 **2. *E. willdenovianum***

1. *Eriocaulon truncatum* Buch.-Ham. ex Mart.

(Latin, *truncatus* = truncate, cut off, ending abruptly;
presumably referring to the truncate floral bracts or sepals)

in Wallich, Pl. Asiat. Rar. 3(11) (1832) 29; Hooker, Fl. Brit. India 6, fasc. 19 (1893) 578; Ridley, J. Straits Branch Roy. Asiat. Soc. 33 (1900) 180; Ridley, Mat. Fl. Malay. Penins. 3 (1907) 54; Ridley, Fl. Malay Penins. 5 (1925) 135; Henderson, Malay. Wild Fls., Monocot. (1954) 212; Soerjani et al., Weeds Rice Indonesia (1987) 280; Keng, Gard. Bull. Singapore 40 (1987) 126; Keng et al., Concise Fl. Singapore, vol. 2, Monocot. (1998) 27; Turner, Gard. Bull. Singapore 45 (1993) 77; Phillips, Rev. Handb. Fl. Ceylon 11 (1997) 73; Chong et al., Checkl. Vasc. Pl. Fl. Singapore (2009) 39, 129, 271; Leach, Telopea 20 (2017) 251; Prajaksood et al., Fl. Thailand 13(3) (2017) 494. **Type:** *Buchanan-Hamilton 6076*, India, Bihar, Munger, 28 June 1811 (lectotype K [K001122955], designated by Phillips, Rev. Handb. Fl. Ceylon 11 (1997) 73; isolectotypes BM [BM000802024], E [E00027110]). **Fig. 1, 2.**

Eriocaulon truncatum Buch.-Ham. ex Mart. var. *malaccense* Hook.f., Fl. Brit. India 6, fasc. 19 (1893) 578; Moldenke, Phytologia Mem. 2 (1980) 296. **Type:** *Griffith s.n.* [Kew Distribution 5567], [Malaysia], Malacca (lectotype K [K000291311], designated here).

Eriocaulon merrillii Ruhland ex Perkins, Fragm. Fl. Philipp. 1 (1904) 136. **Type:** *Merrill 572*, Philippines, Palawan, 24 December 1902 (holotype B [B100296809]; isotypes BM [BM000802020], K [K000291324], SING [SING00054165]).

Eriocaulon glabriflorum Ridl., J. Fed. Malay States Mus. 10 (1920) 155; Ridley, Fl. Malay Penins. 5 (1925) 135. **Type:** *Robinson 6239*, [Malaysia, Kedah], Langkawi, Burau (lectotype K [K000291306], designated here).

Eriocaulon annuum Milne-Redh., Hooker's Icon. Pl. 34 [ser. 5, 4] (1939) pl. 3389. **Type:** *Greenway 5389*, Tanzania, Rufiji District, Mafia Island, Dawe Simba to Ndaagoni (holotype K [K000346129]).

Eriocaulon ciliipetalum H.E.Hess, Ber. Schweiz. Bot. Ges. 65 (1955) 263. **Type:** *Schlieben 2574*, Tanzania, Mafia Island, Ngombeni (holotype Z [Z-000015741]; isotypes LISC [LISC015477, LISC015478]).

Eriocaulon sollyanum Royle var. *sumatranum* P.Royen, Blumea 10 (1960) 135. **Type:** *Bünnemeijer 8950*, Indonesia, Sumatra, Gunung Koerintji, 17 March 1920 (holotype L [L1431071]).

Eriocaulon suishaense Hayata, Icon. Pl. Formos. 10 (1921) 55. **Synonyms:** *Eriocaulon nigrum* Lecomte var. *suishaense* (Hayata) Hatus. & T.Koyama, J. Jap. Bot. 31 (1956) 233. – *Eriocaulon merrillii* Ruhland ex Perkins var. *suishaense* (Hayata) C.E.Chang in Li et al. (ed.), Fl. Taiwan 5 (1978) 185. **Type:** *Hayata s.n.*, Giran, Kōrishō, Taiton, 29 April 1916 (holotype TI).

Eriocaulon suishaense Hayata var. *okinawense* Satake, J. Jap. Bot. 15 (1939) 141. **Type:** *Miyagusuku s.n.*, Japan, Okinawa (holotype TI).

Key to *Eriocaulon truncatum* varieties

1. Capitulum dull yellow-brown with light tinge of grey; petals of female flowers narrowly spatulate, scarious, with or without a brown gland at apex **a. var. truncatum**
 Capitulum yellow-brown, tinged blackish; petals of female flowers oblanceolate, fleshy, with a conspicuous black gland at apex **b. var. florensense**

a. var. truncatum

Short-lived tufted herb. **Leaves** in a rosette, recurved, linear, attenuate, slightly falcate, apex acute, 1.3–6.5 cm long, 2.5–6 mm wide, glabrous, yellow-green. **Scapes** 5–35 per plant, straight when immature, twisting moderately at maturity, 6-ribbed, 6–19 cm long, 0.8–1.4 mm in diam. **Sheath** formed from a single leaf which is tubular at base of each scape, top of sheath spathe-like, apex acute, 2.4–6.5 cm long, c. 2 mm in diam. **Capitulum** hemispherical with tapering apex, 2–3.5 × 3–5.5 mm, dull yellow-brown with light tinge of grey. **Involucral bracts** arranged in a whorl as wide as capitulum, curving upwards through to maturity, elliptic to obovate, apex acute or with a ragged end, margins serrulate, 1.8–2.8 mm long, 1.2–1.3 mm wide, shiny, scarious, very pale yellow to pale yellow-brown. **Floral bracts** imbricate, obovate, oblanceolate or spatulate, apex acute, margins serrulate, 1.2–2.2 mm long, 0.7–1.3 mm wide, shiny, pale yellow to light yellow-brown with tinge of light grey towards apex, lower part translucent, outer surface sparsely covered with white papillate hairs. **Male flowers:** calyx spatheate with bilobed apex and denticulate margins, or 2 sepals with truncate-denticulate apex and partially connate at base, c. 1.3–1.4 × 0.25–0.4 mm, shiny, pale yellow-brown, black towards apex, white-villous hairs at apex; corolla 3-merous, petals triangular, attenuate, pale greenish yellow, apex black, 0.3 × 0.2 mm; stamens 5–6, anthers black, c. 0.2 × 0.15 mm, pollen white with a faint tinge of yellow, vestigial gynoecium usually present; filaments inserted on petals and at the sinus between petals, c. 0.2 mm long. **Female flowers** with 2 sepals, narrowly

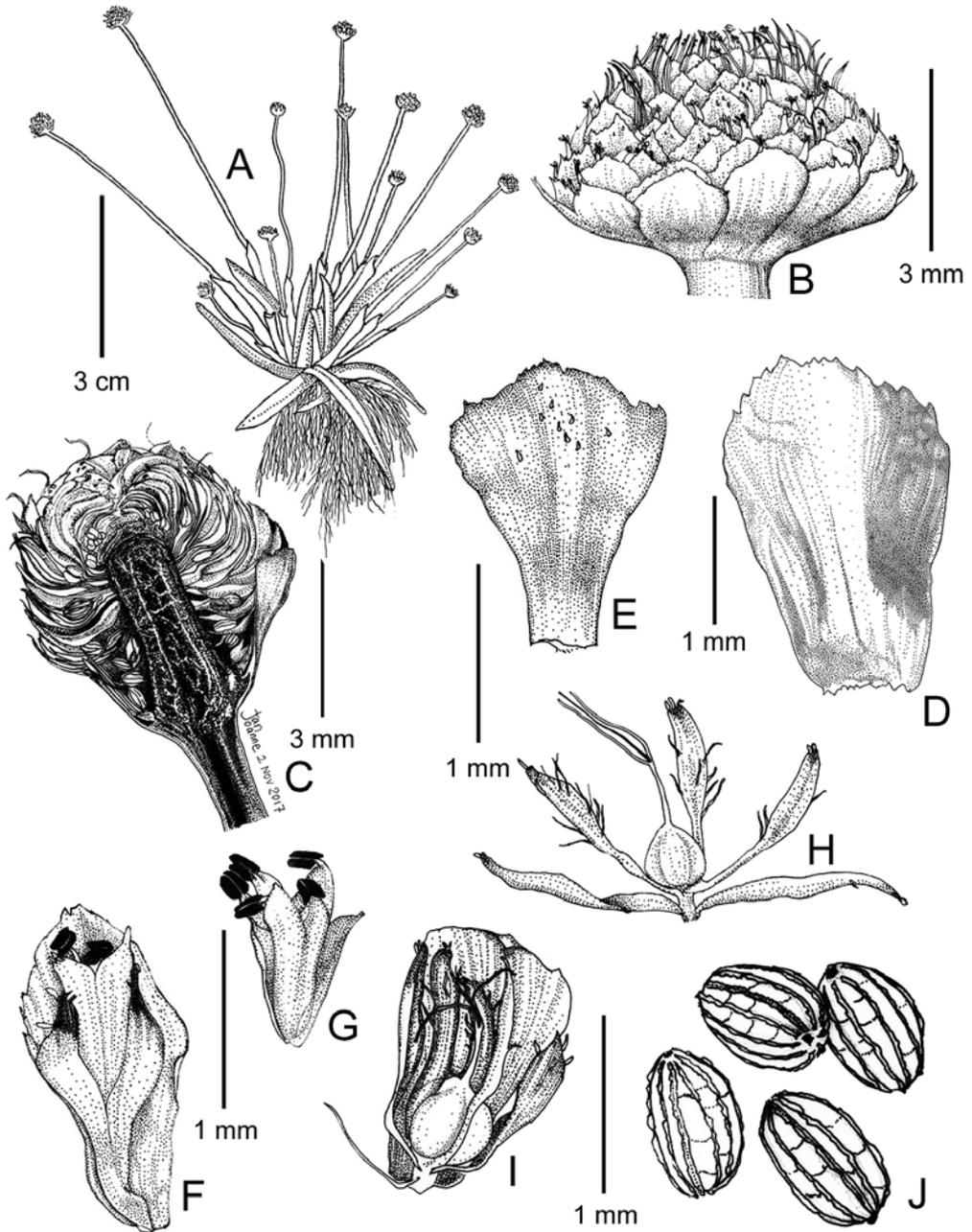


Figure 1. *Eriocaulon truncatum* Buch.-Ham. ex Mart. var. *truncatum*. **A.** Habit. **B.** Capitulum from side. **C.** Longitudinal section of capitulum. **D.** Involucral bract. **E.** Floral bract. **F.** Male flower. **G.** Male flower during anthesis. **H.** Pistil. **I.** Fertilised female flower attached to a floral bract. **J.** Seeds. (From Singapore, Pasir Panjang Nursery, J.P.C. Tan SING2017-534. Drawn by J.P.C. Tan).

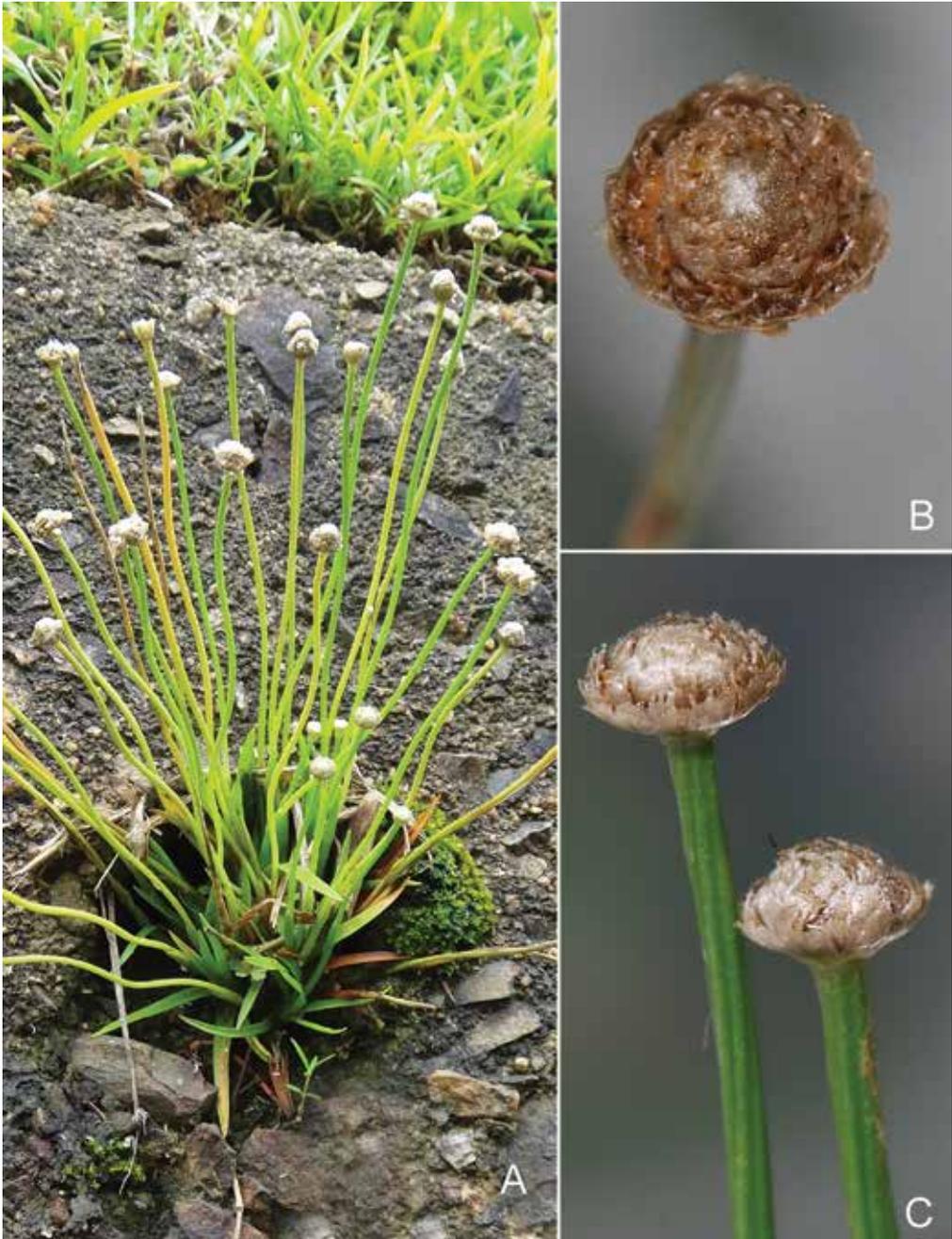


Figure 2. *Eriocaulon truncatum* Buch.-Ham. ex Mart. var. *truncatum*. **A.** Habit. **B.** Capitulum from above. **C.** Capitulum from side. (From Singapore, Pasir Panjang Nursery, J.P.C. Tan SING2017-534. Photos: J.P.C. Tan).

lanceolate or spatulate, attenuate, 1.2–1.4 mm long, shiny, pale yellow-brown, grey from middle part towards apex, with white-villous hairs at apex; petals narrowly spatulate, obtuse, 1–1.3 mm long, very pale yellow-brown, yellow-brown at apex, elongated during and after anthesis, longer papillate white hairs at apex, hyaline long hairs on margin and adaxial surface, exserted beyond floral bract during and after anthesis. **Pistil** 1.4–1.6 mm long; ovary 3-locular, c. 0.4–0.5 × 0.3–0.4 mm, bright yellow with a hint of green; style 0.3–0.4 mm long, white with a faint tinge of yellow; stigma 3-branched, 0.8–1 mm long, white with a faint tinge of yellow to golden brown, exserted beyond floral bract during anthesis. **Seed** 0.39–0.43 × 0.26–0.28 mm, brownish yellow, scalariform, longitudinal cell-walls prominent and thick, surface appearing longitudinally ribbed with white ribbon-like lines.

Distribution. East Africa, India, Sri Lanka, China, Taiwan, Laos, Thailand, Peninsular Malaysia, Indonesia, Philippines and Australia. In Singapore *Eriocaulon truncatum* var. *truncatum* has been collected from drains in Pasir Panjang Nursery (*Tan SING2017-534*, 24 Oct 2017, SING [SING0264220]), in forest such as Nee Soon (*Moo SING2013-186*, 13 Aug 2013, SING [SING0200451]), MacRitchie (*Ridley s.n.*, 1900, SING [SING0012298]), Bukit Mandai (*Ridley 3920*, 1892, SING [SING0012296]), Changi (*Ridley s.n.*, 1890, SING [SING0012294]) and in various others places around Singapore. Drainage has likely led to the loss of suitable habitats.

Ecology. Exposed waterlogged habitats in lowlands, especially in wet sandy soils at lake margins, muddy shallow pools, streams with slow-flowing water, damp clayish soil and drains in urban areas.

Provisional conservation assessment. Globally Least Concern (LC). *Eriocaulon truncatum* was listed as Rare in the first edition of the Singapore Red Data Book (Tan et al. in Ng & Wee (ed.), Singapore Red Data Book (1994) 283) but not mentioned in the second edition (Tan et al. in Davison et al. (ed.), Singapore Red Data Book, 2008). It was listed as a ‘weed of uncertain origin’ in Chong et al. (Checkl. Vasc. Pl. Fl. Singapore (2009) 39, 129, 271). It is assessed here as Least Concern (LC) in Singapore.

Vernacular names. *Short-leaved pipewort* (English), *rumput darya* (Malay).

b. var. florensense Z.X.Zhang (of Flores; epithet presumably misspelt)

Monogr. Gatt. Eriocaulon Ostasien [Diss. Bot. 313] (1999) 183; Prajaksood et al., Fl. Thailand 13(3) (2017) 496. **Type:** *Schmutz 5744*, Indonesia, Lesser Sunda Islands, W. Flores-Manggarai, Pacar, 6 June 1983 (holotype L). **Fig. 3.**

Tufted herb. **Leaves** in a rosette, upper half recurved, linear, attenuate, slightly falcate, apex acute, 2.2–6.5 cm long, 3–5 mm wide, glabrous, yellow-green. **Scapes** 2–11 per plant, straight when immature, twisting moderately at maturity, 5-ribbed, 4–16 cm long, 0.6–0.9 mm in diam. **Sheath** formed from a single leaf which is tubular at base of each scape, top of sheath spathe-



Figure 3. *Eriocaulon truncatum* Buch.-Ham. ex Mart. var. *florensense* Z.X.Zhang. **A.** Habit. **B.** Capitulum from above. **C.** Capitulum from side. (From Singapore, Upper Peirce Reservoir, J.P.C. Tan SING2017-675. Photos: J.P.C. Tan).

like, apex acute, membranous towards apex and margins and often splitting and becoming bifid at maturity, 3–4 cm long, 1.5–2 mm in diam. **Capitulum** broadly crateriform, sometimes viviparous, 1.6–2.2 × 3–5.5 mm, yellow-brown, tinged blackish. **Involucral bracts** arranged in whorl as wide as capitulum, curving upwards sometimes beyond the apex of capitulum, elliptic to obovate, apex acute or with a ragged end, 1.6–2.4 mm long, 1.1–1.3 mm wide, shiny, scarious, pale yellow-brown with tinge of black. **Floral bracts** imbricate, obovate to oblanceolate, apex acute, margins serrulate, 1.1–1.3 mm long, *c.* 0.7 mm wide, shiny, scarious, white with a hint of pale yellow-brown and tinge of black towards apex, lower part translucent, outer surface sparsely covered with white-papillate hairs. **Male flowers:** calyx spatheate with bilobed apex and serrulate margins, or 2 sepals with truncate-denticulate apex and partially connate at base, *c.* 0.6–1.1 × 0.2–0.4 mm, shiny, white with a hint of pale yellow-brown and black towards apex, white-villous hairs at apex; corolla 3-merous, petals triangular, apiculate, white with black apex, 0.15–0.17 × 0.1 mm; stamens 5, anthers black, 0.18–0.24 × 0.13–0.22 mm, pollen white with a faint tinge of yellow; filaments inserted on petals and at the sinus between petals, *c.* 0.3 mm long, vestigial gynoeceum usually present. **Female flowers** with sepals 2, narrowly lanceolate or spatulate, attenuate, 1–1.4 mm long, shiny, black from lower-middle part towards apex, with white-villous hairs at apex; petals oblanceolate, apex obtuse with a conspicuous black gland, 1–1.1 mm long, shiny, fleshy, very pale yellow-brown, hyaline long hairs on margin and adaxial surface. **Pistil** *c.* 1 mm long; ovary 3-locular, 0.5–0.6 × 0.4–0.6 mm, bright yellow; style *c.* 0.2 mm long, white with a faint tinge of yellow; stigma 3-branched, 0.4–0.7 mm long, white with a faint tinge of yellow (before anthesis) to dark brown, exerted beyond floral bract during anthesis. **Seed** 0.5–0.56 × 0.3–0.35 mm, brownish yellow, scalariform, longitudinal cell-walls prominent and thick surface appearing longitudinally ribbed with white ribbon-like lines.

Distribution. Laos, Thailand, Peninsular Malaysia, Sumatra, Java, Sulawesi and New Guinea. In Singapore known only from a forest trail near Upper Peirce Reservoir within the Central Catchment (*Tan SING2017-675*, 28 Nov 2017, SING [SING0239571]).

Ecology. In Singapore known only on an exposed forest trail with muddy ground and shallow stagnant water.

Provisional conservation assessment. Globally Least Concern (LC). This variety is fairly widely distributed in Southeast Asia but is relatively infrequently collected. It is assessed here as Critically Endangered (CR/D) in Singapore.

2. *Eriocaulon willdenovianum* Moldenke

(Carl Ludwig Willdenow, 1765–1812, German botanist
and Director of Berlin Botanic Garden)

Phytologia 18 (1968) 44; Moldenke, Phytologia 19 (1970) 492; Moldenke, Phytologia Mem. 2 (1980) 296; Phillips, Kew Bull. 49 (1994) 296; Phillips, Rev. Handb. Fl. Ceylon 11 (1997) 78; Chong et al., Checkl. Vasc. Pl. Fl. Singapore (2009) 39, 129, 171, as '*wildenovianum*'; Prajaksood et al., Fl. Thailand 13(3) (2017) 502. **Synonyms:** *Eriocaulon longifolium* Nees ex Kunth, Enum. Pl. 3 (1841) 567, nom.

illeg. non Raf. (1840); Mueller, Ann. Bot. Syst. 5 (1858) 947; Körnicke, Linnaea 27 (1854) 690; Van Royen, Nova Guinea, new ser., 10 (1959) 24; Soerjani et al., Weeds Rice Indonesia (1987) 278; Keng, Gard. Bull. Singapore 40 (1987) 126; Keng et al., Concise Fl. Singapore, vol. 2, Monocot. (1998) 27; Turner, Gard. Bull. Singapore 45 (1993) 77; Ansari & Balakrishnan, Fam. Eriocaulaceae India, rev. ed. (2009) 75. – *Eriocaulon sexangulare* L. var. *longifolium* Hook.f., Fl. Brit. India 6, fasc. 19 (1893) 580. **Type:** *Chapelier 2369*, Madagascar (holotype B [B-W02369-01 0]). **Fig 4.**

Eriocaulon wallichianum auct. non Mart.: Thwaites, Enum. Pl. Zeyl., fasc. 5 (1864) 341.

Eriocaulon sexangulare auct. non L.: Ridley, J. Straits Branch Roy. Asiat. Soc. 33 (1900) 180; Ridley, Mat. Fl. Malay. Penins. 3 (1907) 54; Ridley, Fl. Malay Penins. 5 (1925) 133; Henderson, Malay. Wild Fls., Monocot. (1954) 212; Moldenke, Phytologia Mem. 2 (1980) 296.

Eriocaulon longifolium Nees ex Kunth f. *viviparum* Moldenke, Phytologia 7 (1959) 86. **Type:** *Mondi 278*, [Indonesia], Borneo, [Kalimantan], Pontianak, 7 April 1931 (holotype U).

Eriocaulon sexangulare L. f. *viviparum* Moldenke, Phytologia 8 (1962) 388; Moldenke, Phytologia Mem. 2 (1980) 296. **Type:** *Corner 37693*, Malaysia, Johor, Rengam (holotype S).

Perennial, slender tufted herb. **Leaves** in a rosette, linear, attenuate, apex acute to subacute, 6.5–41.5 cm long, 4–7 mm wide, leaf sheath 8–14 mm wide, glabrous, yellow-green, surface often undulate, fenestrate towards the base. **Scapes** 6–9 per plant, straight when immature, slightly twisting when mature, 4–5-ribbed, 9.5–33 cm long, 1–1.5 mm in diam. **Sheath** formed from a single leaf encircling base of each scape, margins inrolled into rigid linear structure, apex acute, 3.8–12.4 cm long, 1.5–2.5 mm in diam. **Capitulum** crateriform to globose or oblate, 3–6 × 4–5.5 mm, dull yellow-brown and covered in a dense layer of white papillate hairs. **Involucral bracts** in a whorl smaller than diameter of capitulum, broadly obovate, saucer-shaped, apex usually rounded, very shallow undulations at margins, 1.9–2 mm long, 2.1–2.4 mm wide, shiny, rigid, yellowish brown, cream coloured at margins. **Floral bracts** tightly imbricate, broadly obovate, apex acute, 1.9–2.1 mm long, 2.1–2.2 wide, shiny, yellow-brown, outer surface densely covered with white papillate hairs. **Male flowers:** calyx spatulate, completely connate or with 2 sepals, concave, sinuate and winged towards apex, 1.5–2 mm long, very pale yellow-brown, translucent when immature; corolla 2-merous, petals triangular or lanceolate, attenuate, 0.4–0.5 mm, white with tinge of yellow, yellow towards apex, white-villous hairs at apex; stamens 4, anthers yellow with a hint of grey to dull brownish yellow, 0.2–0.4 × 0.2 mm, pollen pale yellow; filaments 2 inserted on petals and 2 between petals, c. 0.3–0.5 mm long. **Female flowers** with sepals 2, 1.6–1.8 mm long, each 0.7–0.8 mm wide, shiny, very pale yellow-brown, concave, winged and keeled from lower middle towards apex, apex obtuse; petals narrowly oblanceolate, apex obtuse, 1.3–1.5 mm long, c. 0.1 mm wide, pale yellow-brown, with longer papillate white hairs at apex, hyaline long hairs c. 0.7 mm on margin and adaxial surface. **Pistil** c. 1.9 mm long; ovary 2-locular, 0.7–0.9 × 0.7–0.9 mm, bright yellow with a hint of green; style c. 0.1 mm, pale yellow; stigma 2-branched, c. 0.9 mm long, cream coloured to golden brown; exerted beyond floral bract at anthesis. **Seed** 0.6–0.7 × 0.4–0.5 mm, ellipsoid, dull brownish yellow, hilum dark brown, surface with a flaky appearance.

Distribution. Madagascar, Mauritius, Sri Lanka, Myanmar, Thailand, Peninsular Malaysia, Sumatra, Borneo, Papua New Guinea and Australia. In Singapore it is currently found around



Figure 4. *Eriocaulon willdenovianum* Moldenke. **A.** Habit. **B.** Capitulum from above. **C.** Capitulum from side. (From Singapore, A from MacRitchie Reservoir; B from Upper Peirce Reservoir, *J.P.C. Tan SING2017-676*; C from Tampines *Niissalo SING2019-191*. Photos: A, B, J.P.C. Tan; C, J. Leong-Škorničková).

MacRitchie Reservoir (personal observation) and along waterlogged forest trails near Upper Peirce Reservoir (*Tan SING2017-676*, 28 Nov 2017, SING [SING0264219]). It has also been recorded from Jurong (*Ridley s.n.*, 15 Jul 1889, SING [SING0193845]), the Western Catchment (*Lee WC 77*, 4 May 2004, SING [SING0054974]), Nee Soon (*Samsuri SA1407*, 16 Feb 1977, SING [SING0193846]), Tampines (*Vermeulen 2204*, 29 Dec 2001, SING [SING0043624]) and historically also in other places around Singapore such as Bukit Mandai, Chan Chu Kang and Changi Road.

Ecology. Partial shade and exposed waterlogged habitats, muddy shallow pools, rocky, sandy and muddy margins of reservoirs and streams.

Provisional conservation assessment. Globally Least Concern (LC) as it is widespread within Malesia. In Singapore it is now known from fewer than five localities with fewer than 1000 plants and is assessed here as Vulnerable (VU/D).

Vernacular names. *Long-leaved pipewort* (English), *rumput butang* (Malay), *hua nan gu jing cao* (Mandarin).

Excluded species

Eriocaulon oryzetorum Mart. was reported for Singapore by Hooker (Fl. Brit. India 6, fasc. 19 (1893) 579) and Chong et al. (Checkl. Vasc. Pl. Fl. Singapore (2009) 39, 129, 192) but as no specimens from Singapore have been found, it is unclear to what these reports refer.

