

A NEW SPECIES OF *ERIOCAULON* (*ERIOCAULACEAE*) FROM THE SOUTHERN WESTERN GHATS OF KERALA, INDIA

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A new species of *Eriocaulon*, *E. vamaanae*, is described from the southern Western Ghats of Kerala, India. It resembles *Eriocaulon nepalense* var. *luzulifolium* (Mart.) Praj. & J.Parn. but differs in the shape of its involucral bracts and receptacle, the fusion of the sepals in male flowers, the shape and indumentum of the sepals in female flowers, the size and indumentum of the petals in female flowers, and the seed coat appendages. *Eriocaulon vamaanae* is so far known only from the type locality, Meesapulimala in Idukki District, Kerala, and is assessed as ‘Critically Endangered’ according to the IUCN’s *Red List Categories and Criteria*.

Keywords. Critically Endangered, *Eriocaulon duthei*, *Eriocaulon nepalense* var. *luzulifolium*, *Eriocaulon thwaitesii*, grassland, Meesapulimala.

INTRODUCTION

Eriocaulon L., commonly known as pipeworts, is a genus of about 470 species (WCSP, 2019) in the Eriocaulaceae. The genus is widely distributed but with its centre of diversity in tropical regions (Stützel, 1998). Species of *Eriocaulon* live exclusively in damp or aquatic places (De Oliveira & Bove, 2011) and are mostly acaulescent herbs with a monoecious head inflorescence.

Regional infrageneric classifications of the genus based on morphological data have been provided by various authors: for Indian species by Fyson (1919, 1921, 1922) and Ansari & Balakrishnan (1994, 2009), for Chinese species by Ma (1991, 1997), and for East Asian species by Zhang (1999). In a recent molecular phylogenetic analysis using ptDNA and PHYC datasets by Larridon *et al.* (2019), the existing morphology-based infrageneric classification was reassessed, but the authors refrained from suggesting a new classification because of inadequate sampling. Ansari & Balakrishnan (2009) recognised twelve numbered sections (I–XII) based primarily on seed surface characters for the Indian species of *Eriocaulon*, but these are not supported by Larridon *et al.* (2019).

Ansari & Balakrishnan (2009) reported 80 species from India. Several new taxa were subsequently described from India, bringing the total number to 107 (Shimpale *et al.*, 2009; Shimpale & Yadav, 2010; Vivek *et al.*, 2010; Nampy *et al.*, 2011; Biju *et al.*, 2012; Swapna *et al.*, 2012; Sunil *et al.*, 2013; Rashmi & Krishnakumar, 2014; Sunil *et al.*, 2014; Manudev *et al.*, 2015; Sunil & Naveen Kumar, 2015; Anto & Reshma, 2017; Darshetkar *et al.*, 2017; Manudev *et al.*, 2017; Paithane *et al.*, 2017; Biju *et al.*, 2018; Khanna & Kumar, 2019).

During floristic investigations in Idukki District, some interesting specimens of *Eriocaulon* were collected on the way to Meesapulimala (2640 m), the second highest peak in South India. A critical study using the available literature and specimens demonstrated that these are quite different from any of the known taxa, and they are described and illustrated here as *Eriocaulon vamaanae*.

MATERIALS AND METHODS

The material for the present study was collected during field trips in Idukki District, Kerala. Specimens were pickled in 4% formalin and 70% ethanol for laboratory study. The distribution and density of the species were observed by frequent field trips to the study area. Photographs were taken with a Stemi 508 stereomicroscope (Zeiss, Oberkochen, Germany) attached to an AxioCam 105 colour camera (Zeiss). Herbarium sheets were prepared by conventional methods (Bridson & Forman, 1991) and deposited in Calicut University Herbarium (CALI).

The identity of the species was confirmed with types or protologues and through consultation of online data sources (B, BM, CALI, E, K and MH). Detailed descriptions were prepared after proper diagnosis by examining the specimens. Seed micromorphology was studied with a scanning electron microscope (Zeiss Gemini SEM 300 Microscope).

SPECIES DESCRIPTIONS

***Eriocaulon vamaanae* Dani & Nampy, sp. nov.**

Eriocaulon vamaanae is morphologically close to *Eriocaulon nepalense* var. *luzulifolium* (Mart.) Praj. & J.Parn. but differs in the shape of its involucral bracts (oblong versus broadly ovate) and receptacle (obovoid versus convex), nature of male sepals (free versus fused), shape and hairiness of female sepals (boat-shaped and glabrous versus linear to narrowly oblanceolate and hoary at apex), size and hairiness of female petals (1.1 mm long, barbate versus 1.5 mm long, hairy at apex) and number of seed coat appendages (1 or very rarely 2 versus 1–4). – Type: India, Kerala, Idukki District, Munnar, Meesapulimala, ± 2445 m, 10°05'22.7" N, 77°11'27.1" E, 21 xii 2018, Dani Francis & Santhosh Nampy 167894 (holo CALI!, iso CAL). **Figs 1–4.**

Acaulescent herbs, 1–3 cm tall. *Root stock* absent. *Leaves* green, linear, 0.9–2 × 0.1–0.2 cm, apex acute, broadening slightly towards base, margin entire, ciliate. *Sheath* 0.6–2 cm long, terete, ciliate; limb 6–9 × 2 mm, lanceolate, apex narrowly acute, ciliate. *Head* 2–3 mm across, hemispherical, black to straw-coloured. *Peduncles* many, 0.6–2.7 cm long, pubescent. *Receptacle* obovoid, 1 × 1 mm, pilose. *Involucral bracts* 2–2.1 × 1–2 mm, oblong, apex obtuse to subtruncate, base truncate, glabrous to sparsely hoary, blackish, margins entire. *Floral bracts* 2 × 0.8 mm, oblanceolate, apex acuminate, base cuneate, sparsely hoary towards apex, straw-coloured. *Male flowers*: stipe 0.2–0.3 mm, basally hairy. *Sepals* 3, free, obovate to oblanceolate, 1 × 0.8 mm, obtuse to acute at apex, cuneate at base, sparsely hoary towards apex, straw-coloured. *Stipe* of corolla 0.6 mm. *Petals* 3, equal,

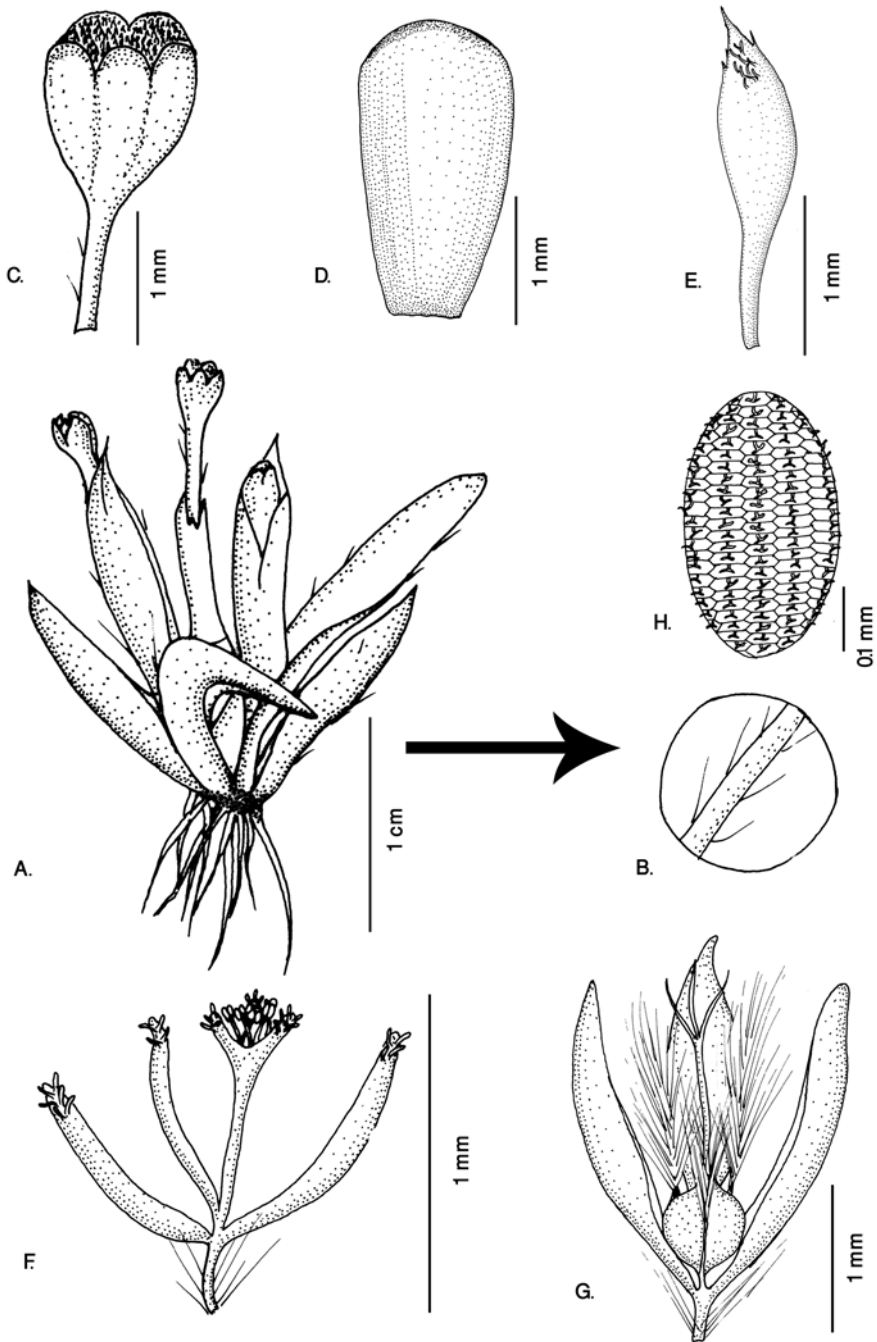


FIG. 1. *Eriocaulon vamae* Dani & Nampy, sp. nov. A, Habit; B, hair pattern; C, head; D, involucre; E, floral bract; F, male flower; G, female flower; H, seed. Drawn by Dani Francis.



FIG. 2. *Eriocaulon vamae* Dani & Nampy, sp. nov. A, Habit; B, involucral bract; C, floral bract; D, male flower; E, male flower with sepals and petals spread out; F, female sepals; G, female petals; H, gynoecium with petals; I, seeds. A–I from Dani Francis & Santhosh Nampy 167894.

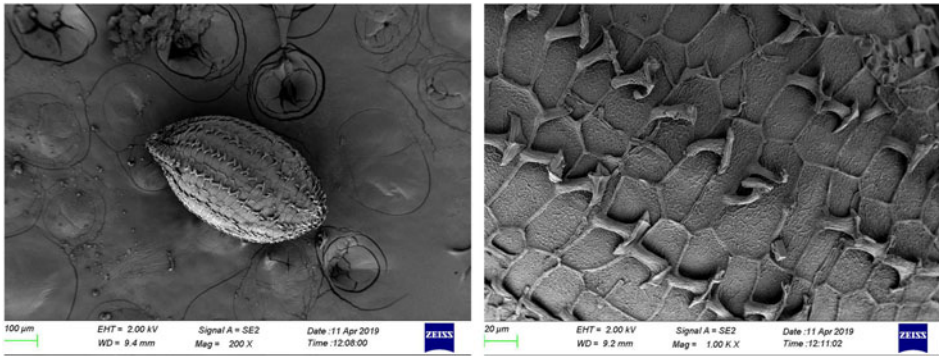


FIG. 3. Scanning electron micrograph showing seeds of *Eriocaulon vamae* Dani & Nampy.

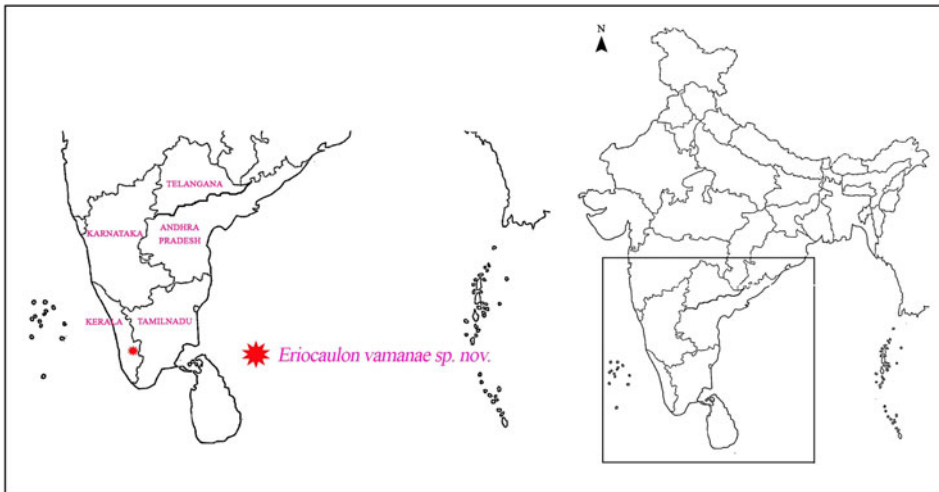


FIG. 4. Map showing the distribution of *Eriocaulon vamae* Dani & Nampy.

0.2 mm, oblong, apex obtuse, hoary towards apex with a black gland, hyaline. *Stamens* 6; filaments 0.2 mm, white; anthers black. *Female flowers*: stipe 0.2 mm, basally hairy. *Sepals* 3, free, subequal, 1.6–2 mm, boat-shaped; lateral sepals conduplicate, apex obtuse to subacute, base cuneate, glabrous, blackish to straw-coloured. *Petals* 3, 1.1 mm, linear, narrow, barbate, eglandular, hyaline, not clawed, stipitate between sepals and petals. *Ovary* oblong, 0.4 × 0.4 mm; style 1.1 mm; stigma trifid. *Seeds* 0.4 × 0.3 mm, elliptic to oblong, seed coat cells transversely elongated, appendages solitary or very rarely two from the middle of each transverse radial wall, setiform, dilated at apex.

Distribution and habitat. Known only from the type locality, where it grows in wet meadows around mountain springs, along with species of *Utricularia* L. (Lentibulariaceae), *Apocopsis*

TABLE. Diagnostic morphological characters of *Eriocaulon vamae* sp. nov., *E. nepalense* var. *luzulifolium* (Mart.) Praj. & J.Parn., *E. duthiei* Hook.f. and *E. thwaitesii* Körn.

Character	<i>Eriocaulon vamae</i>	<i>Eriocaulon nepalense</i> var. <i>luzulifolium</i>	<i>Eriocaulon duthiei</i>	<i>Eriocaulon thwaitesii</i>
Peduncles	0.6–2.7 cm, pubescent	Up to 3–22 cm, glabrous	2.5–12 cm, glabrous	Up to 18 cm, glabrous
Sheath	0.6–2 cm, ciliolate	1–7 cm, glabrous	Up to 3 cm, glabrous	Up to 6 cm, glabrous
Limb	Lanceolate	Ovate	Ovate	Ovate
Receptacle	Obovoid, pilose	Convex, villous	Ovoid to cylindric, glabrous	Convex, villous
Involucral bracts	Oblong	Broadly obovate	Oblong to lanceolate	Oblong
Floral bracts	Oblanceolate, sparsely hoary towards apex	Oblanceolate to oblong, hoary towards apex	Oblong to lanceolate, glabrous	Oblanceolate to cuneate, sparsely hoary towards apex
Male flower				
Sepals	3, free, 1 × 0.8 mm, obtuse to acute at apex, sparsely hoary towards apex	3, fused, 1.5–2 mm long, acute at apex, hoary towards apex	2, free, c.1 mm long, subacuminate at apex, glabrous	2 or with a minute protuberance in between the lobes, connate into a spathe, c.1 × 1.25 mm, obtuse, glabrous or sparsely hoary at apex
Petals	Hoary towards apex	Glabrous, or if unequal the longest petal hairy	Glabrous	Sparsely hoary towards apex
Female flower				
Sepals	3, 1.6–2 mm, boat-shaped, obtuse to subacute, glabrous	3, 2 mm, linear to narrowly oblanceolate, acute, densely hoary at apex	2, c.0.75 mm, linear to elliptic, acuminate, glabrous	3 (or 2), 1.75–2 mm, lateral sepals obovate to oblanceolate, conduplicate, sparsely hoary at apex
Petals	Linear, narrow, barbate, 1.1 mm	Linear, hairy at apex, 1.5 mm	Linear, glabrous, c.0.75 mm	Linear, barbate, c.0.75 mm
Seed coat appendages	1 or very rarely 2 from the middle of transverse radial walls	1–4 from the middle of transverse radial walls	1–3 from the middle of transverse radial walls	1 from the middle of transverse radial walls

Nees (Poaceae), *Eriocaulon idukkianum* Manudev, Robi & Nampy and a few bryophytes (*Campylopus* sp.), at an elevation of \pm 2445 m.

Phenology. Flowering and fruiting from November to January.

Additional specimens examined. INDIA. Kerala, Idukki District, on the way to the summit of Meesapulimala, \pm 2445 m, 31 xii 2018, *Dani Francis & Vishnu Mohan* 167899 (CALI!).

Conservation status. The extent of occurrence of the species is estimated to be less than 100 km² and the area of occupancy less than 10 km². A single population consisting of 95 individuals was observed in the area. Because the type locality is a tourist destination, it is vulnerable to destruction. According to IUCN criteria (IUCN, 2012; IUCN Standards and Petitions Subcommittee, 2017), *Eriocaulon vamanae* is assigned to the category 'Critically Endangered'.

Eriocaulon vamanae is morphologically close to *E. nepalense* var. *luzulifolium* (Mart.) Praj. & J.Parn. but differs by the shape of the involucre bracts (oblong versus broadly ovate) and receptacle (obovoid versus convex), fusion of male sepals (free versus fused), shape and hairiness of female sepals (boat-shaped and glabrous versus linear to narrowly oblanceolate and hoary at apex), size and hairiness of female petals (1.1 mm, barbate, versus 1.5 mm, hairy at apex) and number of seed coat appendages (1 or very rarely 2 versus 1–4). *Eriocaulon vamanae* differs from *E. duthiei* Hook.f. by the length of the peduncle (0.6–2.7 cm versus 2.5–12 cm), nature of receptacles (obovoid and pilose versus ovoid to cylindrical and glabrous), shape of floral bracts (oblanceolate versus oblong to lanceolate), number of male and female sepals (2 versus 3) and indumentum of the female petals (barbate versus glabrous). It differs from *Eriocaulon thwaitesii* Körn., a common species in the area, in the size of plants (1–3 cm tall versus c.18 cm), size of leaves (0.9–2 × 0.1–0.2 cm versus c.9 × 0.2 cm), shape of limb (lanceolate versus ovate), shape and hairiness of receptacle (obovoid and pilose versus convex and villous), fusion of male sepals (free versus fused) and nature of female sepals (not keeled versus keeled). The characters differentiating *Eriocaulon vamanae* from other species are listed in the Table.

Etymology. The epithet *vamanae* means 'dwarf' in Sanskrit and refers to the small size of the plant.

KEY TO SPECIES OF *ERIOCAULON* IN IDUKKI DISTRICT, KERALA

- 1a. Female petals 2.7–3.2 mm broad, distinctly clawed _____ *E. rhodae*
 1b. Female petals 0.1–1 mm broad, not clawed _____ 2
- 2a. Plants without tubers. Anthers black _____ 3
 2b. Plants with tuber. Anthers white _____ *E. idukkianum*
- 3a. Seed coat cells transversely or vertically elongated _____ 5
 3b. Seed coat cells isodiametric _____ 4

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- 4a. Root stock absent, peduncles 5–17 _____ *E. biappendiculatum*
 4b. Root stock present, peduncles 1–3 _____ *E. nairii*
- 5a. Seed coat appendages ribbon-like or rectangular _____ 6
 5b. Seed coat appendages setiform _____ 7
- 6a. Sepals 2 in male flowers. Seed coat cells vertically elongated _____ *E. truncatum*
 6b. Sepals 3 in male flowers. Seed coat cells laterally elongated _____ *E. quinquangulare*
- 7a. Male sepals free _____ 8
 7b. Male sepals fused _____ 9
- 8a. Female sepals broadly keeled outside _____ *E. eurypeplon*
 8b. Female sepals not keeled outside _____ ***E. vamanae***
- 9a. Seed coat appendages with appendages arising from their angles ____ *E. vasudevani*
 9b. Seed coat cells with appendages arising from their transverse radial walls _____ 10
- 10a. Male petals unequal _____ *E. odoratum*
 10b. Male petals equal or subequal _____ 11
- 11a. Seed coat appendages solitary from the transverse radial wall _____ 12
 11b. Seed coat appendages 2 to many from the transverse radial wall _____ 13
- 12a. Leaves 9 × 0.2 cm, glabrous _____ *E. thwaitesii*
 12b. Leaves 15–40 × 1.2 cm, pubescent _____ *E. brownianum*
- 13a. Seed coat appendages arranged in vertical rows on the surface of seeds *E. nepalense*
 13b. Seed coat appendages arranged in transverse ring on the surface of seeds _____ 14
- 14a. Male sepals obtuse or acute at apex _____ *E. parviflorum*
 14b. Male sepals truncate at apex _____ *E. xeranthemum*

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