

Nymphoides krishnakesara var. *bispinosa* (Menyanthaceae), a new taxon from the lateritic plateau of Northern Kerala, India

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Abstract

A new taxon *Nymphoides krishnakesara* var. *bispinosa*, is described and illustrated from ponds on the lateritic plateau of northern Kerala, India. It is distinguished from the similar *N. krishnakesara* var. *krishnakesara* by the presence of two stout spines on seeds, and pinkish tinged veins on the floating leaves. A detailed description, illustration of both male and female plants, photographs of a specimen from the type location, and a table of comparative characters are provided.

Introduction

The aquatic genus *Nymphoides* Séguier is widely distributed in the wetlands of tropical and temperate regions of both the old and new worlds (Sivarajan et al.1989). The genus contains approximately 50 species (Tippary et al. 2008), eight of which are found in India (Gupta et al.1999). Sivarajan et al. (1993) studied the Indian species of *Nymphoides* proposing two sections: Sect. *Nymphoides* containing one species, and Sect. *Nymphaeantha* containing seven species. The genus includes both dioecious and bisexual species, although the dioecious condition is very rare. Of the four known dioecious species, two are found in India namely *N. krishnakesara* Joseph & Sivar. and *N. macrospermum* Vasudevan (Tippary et al. 2011). The bisexual species in India are *N. aurantiaca* (Dalz.) Kuntze., *N. hydrophylla* (Lour.) Kuntze., *N. indica* (L.) Kuntze., *N. parvifolia* Kuntze., *N. sivarajanii* Joseph. and *N. peltata* (S. G. Gmel.) Kuntze. It is difficult to distinguish between species based on dried specimens, due mainly to the poor condition of the dried flowers (Ornduff 1969). For this reason Sivarajan et al. (1989) instead used both seed surface ornamentation and leaf epidermal patterns for identification, finding clear differences between species.

During a field study on a lateritic plateau in the Southern Western Ghats, the authors noticed an interesting population of *Nymphoides* growing in seasonal ponds. Although these plants resembled *N. krishnakesara*, seeds appeared to differ in their structure across the whole population, involving six seasonal ponds on the same plateau. A detailed study of these specimens revealed differences in seed structure from that of *N. krishnakesara*, and we here provide a description of this new variety.

Taxonomy

Nymphoides krishnakesara var. *bispinosa* Biju, Josekutty, Haneef & Augustine J. var. nov.

Diagnosis: *Nymphoides krishnakesara* var. *bispinosa* is allied to *N. krishnakesara* var. *krishnakesara* but differs in having the veins of the floating leaves, and calyx lobe tips, tinged pinkish, discoid seeds with a spine on each side, and ovary lacking hypogynous glands.

Type: India: Kerala: Kasaragod District, Kakkad lateritic plateau, 12°16'28.5" N, 075°14'05.6" E, alt. 82 m, Biju & Jomy 2464 (female specimen), 22 July 2014 (holo: CAL, iso: MH). Biju & Jomy 2465 (male specimen) (para: CAL).

Rhizomatous aquatic herb, dioecious, with floating leaves. *Rhizome* vertical, unbranched, obconical, 4–10 × 1–2.5 cm. *Roots* numerous, spongy, branched or unbranched. *Basal sterile leaves* spatulate or triangular; lamina rhombic-linear, 0.8–1 × 0.4–0.6 cm, petiolate or sessile; petiole spongy, flattened, 0.5–0.8 mm long, green; leaf base expanded, 0.5–1 cm diam., triangular, margins winged, hyaline. *Fertile branches* many, borne in axils of basal sterile leaves, green, gland-dotted, spongy, terete, up to 100 cm long, length dependent on water depth, uniphyllous, floating leaves petiolate; petiole 1–2 mm long; lamina ovate-elliptic, 6–7.5 × 7–8 cm; glabrous above, gland dotted below; apex obtuse-round; margin repand-sinuate; deeply cordate at the base, sinus broadly triangular; veins palmately reticulate, tinged pinkish. *Male inflorescence* umbellate cluster with 60 or more flowers at the junction of leaf and branch, protected by triangular membranous sheath formed from leaf base, bracteate; bracts triangular-ovate, 3–6 × 2–4 mm, membranous, single veined, greenish. *Male flower* c. 1 cm diam.; pentamerous or hexamerous; pedicel 3–6 cm long, pinkish, gland-dotted; sepals 5(–6), sepal 4–5.5 × 1.5–2 mm, imbricate, reflexed in opened flower, pinkish; corolla rotate, white, lobes 5(–6), valvate, induplicate in bud, revolute in open flower, tube 2 mm long, lobes 7–9 × 2–2.5 mm, longitudinally grooved near middle; margin winged, wing 0.4–0.5 mm, incised; median wing at the apex only, 2.5–3 × 2.5–3 mm, incised; stamens 5(–6), epipetalous, arise from the base of the corolla tube, basifixed, bithecos; anther 2–2.5 × 0.7–0.8 mm, deep purplish, oblong; filament 2–2.5 mm, base broad; anther longitudinally dehiscent, lobes spirally twisted, exposing inner surface of anther wall with pollen grains, yellow, alternates with 1–3 stalked glands; glands 0.2–0.3 × 0.1–0.15 mm, apex covered by glandular hairs, base expanded into a membrane that connects filaments making them narrowly monoadelphous; pistillode oblong, 2.5–3 × 1–1.5 mm, apex bilobed or trilobed, 5 yellowish globular glands at the base. *Female inflorescence* in umbellate cluster of 6–20 flowers, protected by triangular membranous sheath formed from the leaf base; bracts similar to that of male flowers. *Female flower* small, c. 0.7 mm diam., pentamerous or hexamerous, pedicellate; pedicel short, 1–1.5 mm, gland-dotted; sepals 5(–6), free, imbricate, 4–5 × 1–1.5 mm, lanceolate, obtuse, pinkish, margins hyaline, reflexed; corolla rotate, white, corolla tube short, up to 1.2 mm, lobes 5(–6), petals lobes 5–6.5 × 1.2–1.5 mm, white, rotate, longitudinally grooved at middle, grooved, involute in the bud, revolute in open flower; margins winged, 0.3–0.4 mm long, incised; median wings 2–2.2 × 1.5–1.7 mm, incised. *Staminodes* 5, epipetalous, linear, 0.4–0.6 × 0.1–0.2 mm, hyaline; filament 0.3 mm long; stalked glands 1–3, alternates with staminodes, base expanded forming membrane; ovary 2–2.2 × 1–1.3 mm, ovary roughly four-sided, unilocular, ovules many, parietal placentation, hypogynous glands absent; style short, 0.5–0.6 mm long, minutely muricate; stigma bilobed, covered by long papillate hairs; hairs 1.5–2 mm long. *Fruit* ovoid, 0.8–1 × 0.5–0.6 cm, surface irregularly lobed, apiculate, fruiting calyx deflexed. *Seeds* 3–7, 3.5–4 × 2.5–3 × 0.3–0.4 mm, discoid, brownish, laterally compressed, aculeate throughout, single spine on both sides, 0.8–1 mm long, stout. **Figs 1–3.**

Distribution and ecology: India: endemic to the lateritic hillocks of Kakkad, Northern Kerala in the Southern Western Ghats. Found growing in shallow seasonal ponds on a lateritic plateau, in association with *Eriocaulon cuspidatum* Dalz., *Rotala tulunadensis* Prasad, Biju, Ravi & Bhat, and *Wiesneria triandra* (Dalz.) Micheli. Plants are propagated by seed. The thick rhizome perennates during the dry season.

Phenology and pollination: Flowering and fruiting in July–December. Flowers begin to open in the early morning and fully open within 2–3 hours. During this period, the petal lobes of both male and female flowers bend backward along the median longitudinal groove, becoming laterally folded. Simultaneously, the purplish anther lobes dehisce longitudinally, twisting spirally, and exposing the yellowish pollen grains of the inner wall. The body of any insect collecting nectar from the interstaminal nectary glands is coated with pollen grains. In the female flowers nectary glands are located between staminodes, where pollen grains are easily transferred to the papillate stigmatic hairs.

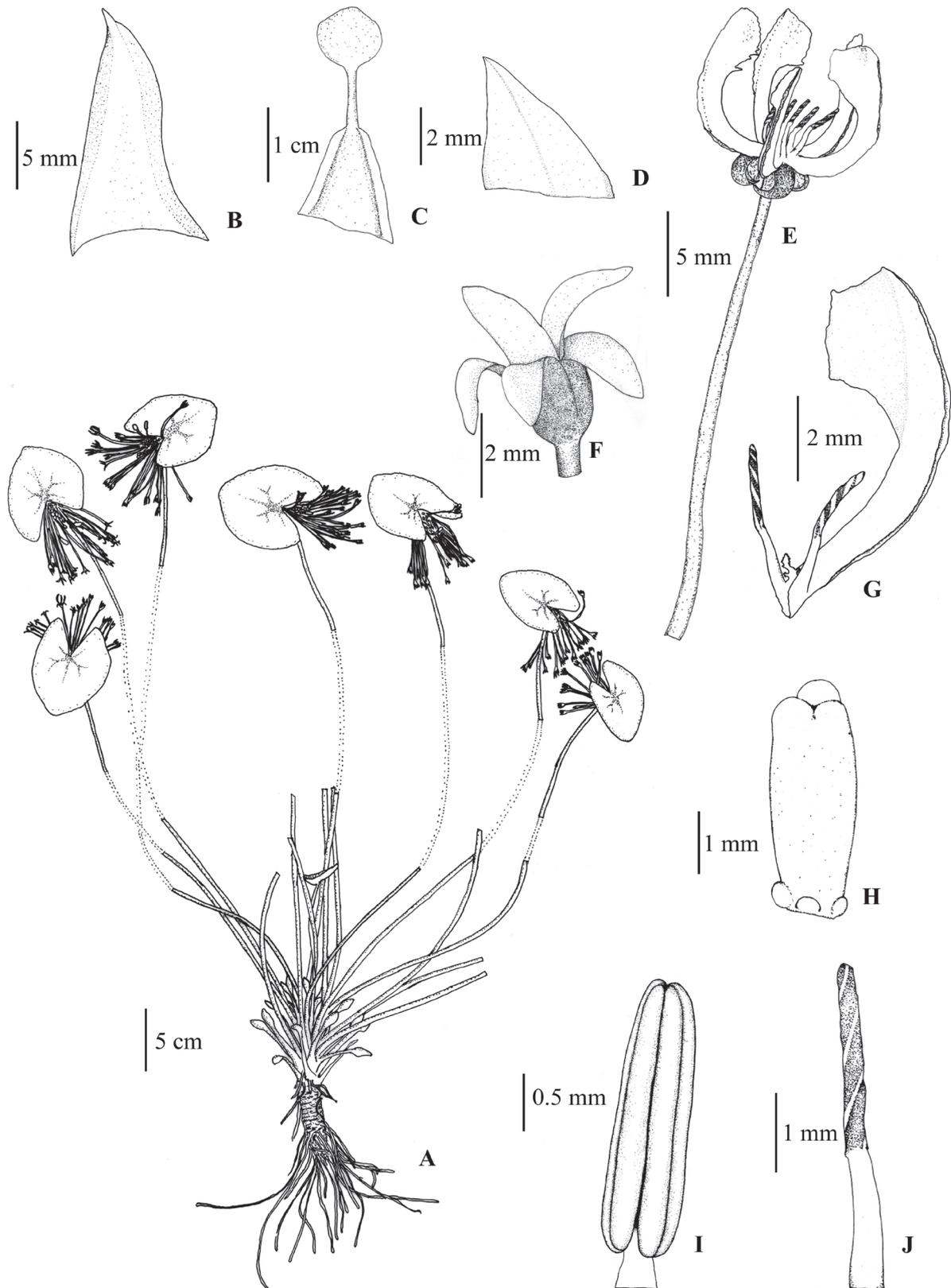


Fig. 1. *Nymphoides krishnakesara* var. *bispinosa*: A, habit (male plant); B and C, basal leaves; D, bract; E, male flower; F, calyx; G, petal lobe with stamens and interstaminal glands; H, pistillode with hypogynous glands; I, stamen in bud; J, stamen in open flower. Drawn by P. Biju from *Biju & Jomy* 2465 (CAL).

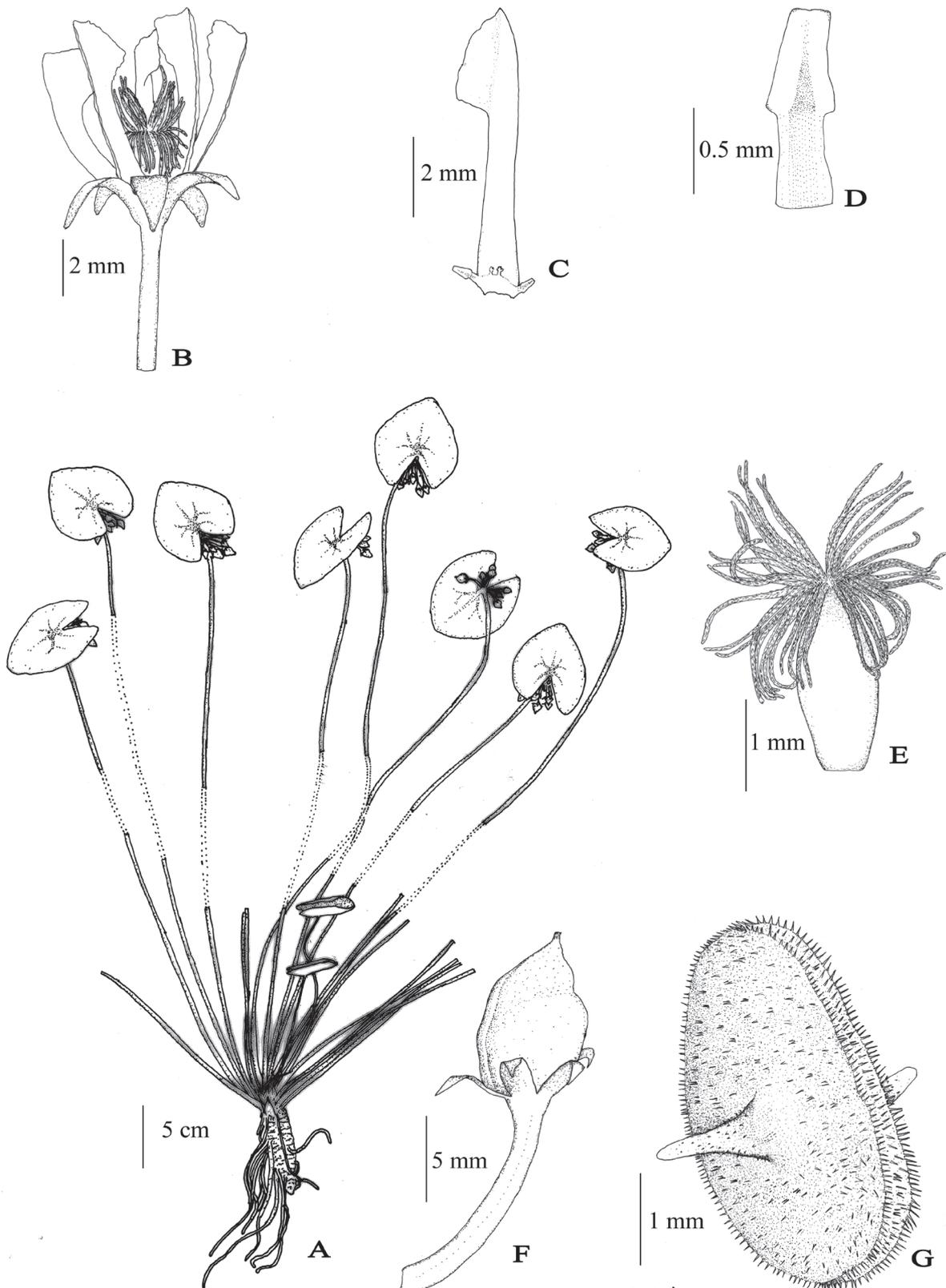


Fig. 2. *Nymphoides krishnakesara* var. *bispinosa*: A, habit (female plant); B, female flower; C, petal lobe with staminodes and interstaminal glands; D, staminode; E, carpel; F, fruit; G, seed. Drawn by P. Biju from Biju & Jomy 2464 (CAL).

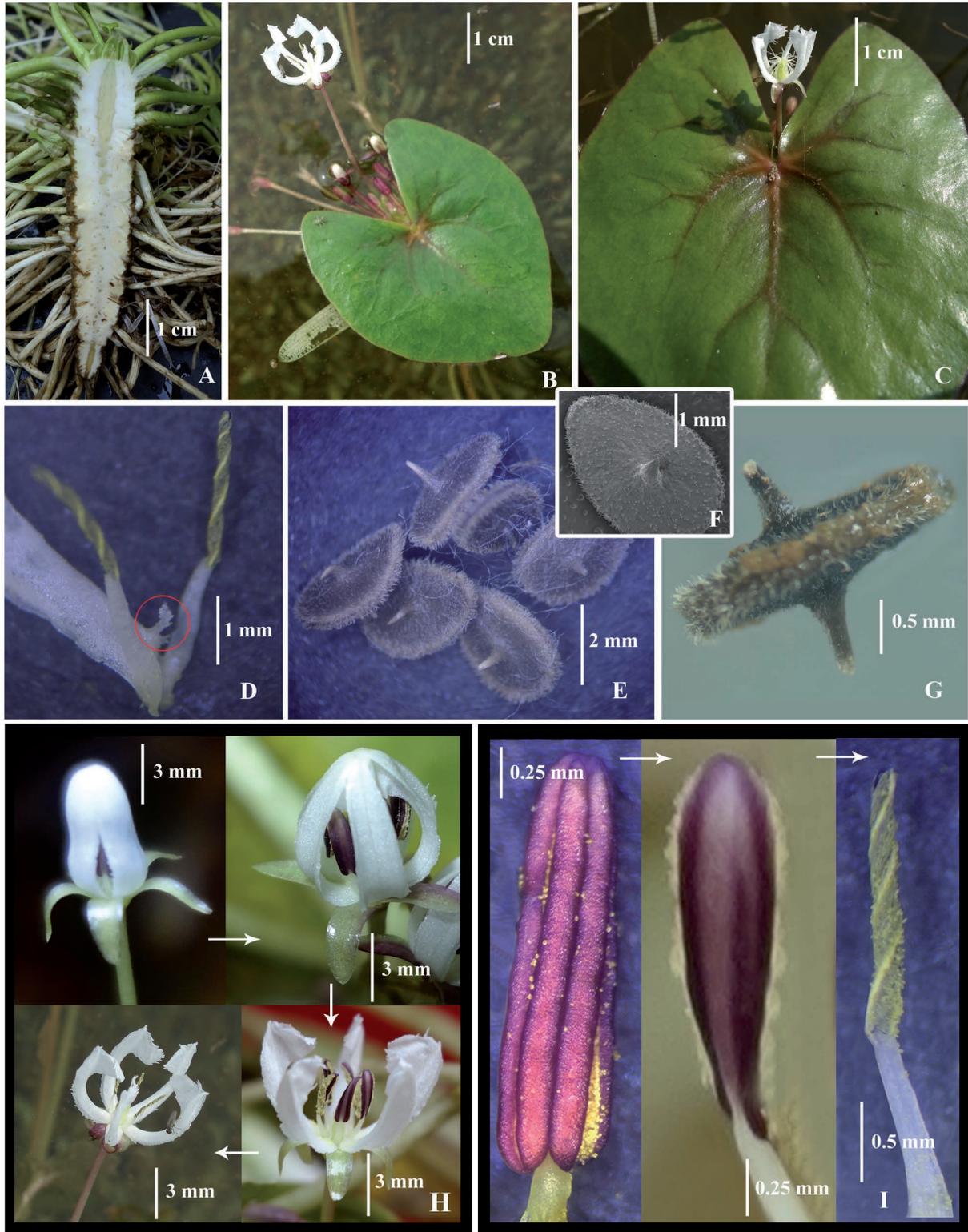


Fig. 3. *Nymphoides krishnakesara* var. *bispinosa*: A, rhizome (longitudinal section); B, male flower; C, female flower; D, petal lobe with stamens and interstaminal glands; E, seeds; F, seed (SEM image); G, single seed; H, changes of corolla during opening of flower; I, changes of stamen during opening of flower. Images from type location by P. Biju.

Relationships: *Nymphoides krishnakesara* var. *bispinosa* is closely allied to *N. krishnakesara* var. *krishnakesara*, but differs by the presence of pinkish veins on the leaves, pinkish calyx lobes, 3-7 seeded capsule, a stout spine on each lateral surface of the discoid seed, and the absence of hypogynous glands on the carpel (Table 1).

Table 1. Morphological characters differentiating *N. krishnakesara* var. *bispinosa* from *N. krishnakesara* var. *krishnakesara*.

Characters	var. <i>bispinosa</i>	var. <i>krishnakesara</i>
Leaf veins	pinkish	yellowish green
Flowers	pentamerous or hexamerous	pentamerous
Calyx lobes	apex pinkish	apex greenish
Carpel; hypogynous glands	absent	five distinct
Seeds per capsule	3-7	5-10
Seed shape	discoid, two long, stout spines present	discoid, spines absent

Etymology: The varietal epithet refers to the key character of the discoid seed surface possessing a long stout spine on either side of the seed.

Conservation status: The variety is known only from the type location. Due to the limited information on the present status, we recommend treating it under the Data Deficient (DD) category (IUCN Standard and Petitions Subcommittee 2014). Future field studies are required to estimate the distribution, and to establish an appropriate conservation status.

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References

- Joseph KT (1991) *Nymphoides sivarajanii* (Menyanthaceae), a new species from India. *Willdenowia* 20: 135-138.
- Joseph KT, Sivarajan VV (1990) A new species of *Nymphoides* (Menyanthaceae) from India. *Nordic journal of Botany* 10: 281-284. <https://doi.org/10.1111/j.1756-1051.1990.tb01773.x>
- Gupta S, Mukherjee A, Mondal M (2000) A review of the Menyanthaceae Dumortier in India. *Acta Botanica Hungarica* 42: 119-137.
- IUCN Standards and Petitions Subcommittee (2014) Guidelines for Using the IUCN Red List Categories and Criteria. Version 11. Prepared by the Standards and Petitions Subcommittee. Downloadable from www.iucnredlist.org/documents/RedListGuidelines.pdf
- Ornduff R (1969). Neotropical *Nymphoides* (Menyanthaceae): Meso-American and West Indian species. *Brittonia* 21: 346-352. <https://doi.org/10.2307/2805761>
- Sivarajan VV, Joseph KT (1993) The genus *Nymphoides* Séguier (Menyanthaceae) in India. *Aquatic Botany* 45: 145-170. [https://doi.org/10.1016/0304-3770\(93\)90019-S](https://doi.org/10.1016/0304-3770(93)90019-S)
- Sivarajan VV, Chaw SM, Joseph KT (1989) Seed coat micromorphology of Indian species of *Nymphoides* (Menyanthaceae). *Botanical Bulletin of Academia Sinica* 30: 275-283.
- Schmidt-Mumm Udo (2005) Notes on the genus *Nymphoides* (menyanthaceae) of Colombia. *Caldasia* 27: 127-130.
- Tippary NP, Les DH (2011) Phylogenetic relationships and morphological evolution in *Nymphoides* (Menyanthaceae). *Systematic botany* 36: 1101-1113. <https://doi.org/10.1600/036364411X605092>
- Tippary NP, Les DH, Padgett DJ, Jacobs SWL (2008) Generic circumscription in Menyanthaceae: a phylogenetic evaluation. *Systematic Botany* 33: 598-612. <https://doi.org/10.1600/036364408785679851>
- Vasudevan R (1968) A new species of *Nymphoides* (Menyanthaceae) from South India. *Kew Bulletin* 22: 101-106. <https://doi.org/10.2307/4107828>