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Euphorbia ravii (Euphorbiaceae: subg. *Euphorbia*), a new species from Andhra Pradesh, India

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ABSTRACT: *Euphorbia ravii* is described as a new species from Nigidi hills, Ananthapuramu district of Andhra Pradesh, India. It belongs to the subgenus *Euphorbia* section *Euphorbia*, it is closely allied to *E. caducifolia* but differs in many attributes which are discussed here. An updated key for Indian *E. caducifolia* group is also provided for easy identification.

KEY WORDS: Deccan Plateau, *Euphorbia caducifolia*, Nigidi hills, preliminary conservation status, section *Euphorbia*.

INTRODUCTION

Euphorbia L. is one of the largest genera of flowering plants and the most species-rich in the family Euphorbiaceae with more than 2000 species distributed throughout the world with highest diversity found in arid and semi-arid regions of the tropics and subtropics (Horn *et al*., 2014; Mabberley, 2017). The genus includes geophytes, herbs, shrubs, trees, and a host of succulent and xerophytic form and is characterized by distinctive morphological synapomorphy, the cyathium inflorescence (Horn *et al*., 2012). Based on molecular phylogenetic studies (Bruyns *et al*., 2006; Steinmann and Porter, 2002; Zimmermann *et al*., 2010; Horn *et al*., 2012), the genus *Euphorbia* has classified into 4 subgenera namely, *Athymalus* (as *Rhizanthium*) (Peirson *et al*., 2013), *Chamaesyce* (Yang *et al*., 2012), *Esula* (Riina *et al*., 2013) and *Euphorbia* (Dorsey *et al*., 2013). In India, the genus is represented by 91 species of which 38 are endemic (Binojkumar and Balakrishnan, 2010, 2012; Sarojinidevi, 2017; Sarojinidevi and Raju, 2014; Sarojinidevi and Swamy, 2018; Prasad and Prasanna, 2016; Malpure *et al*., 2016; Malpure *et al*., 2021a,b).

In the course of the floristic study of Ananthapuramu district (Andhra Pradesh, part of Decan Plateau), an interesting and chasmophytic species of *Euphorbia* was collected by the senior author from open scrub forest. After critical examination of the collected specimens, and perusal of literature revealed that the collected specimens belong to the subgenus *Euphorbia* and section *Euphorbia* (Dorsey *et al*., 2013) based on succulent habit and spine-shields characters. The section *Euphorbia* is represented by more than 350 species and mostly distributed in Africa and a few species in South and Southeast Asia and it is limited into the Arabian Peninsula and Pakistan in north and west respectively and has no representatives in other SW Asian countries (Dorsey *et al*., 2013; Pahlevani *et al*., 2020). In India, the section *Euphorbia* is represented by 26 taxa of which 15 are endemics. Of the 26 recorded taxa, 4 species *Euphorbia lacei* Craib, *E. lactea* Haw., *E. mauritanica* L. and *E. trigona* Miller are widely cultivated for ornamental purpose. The typical characters of section *Euphorbia* are succulent habit and spine-shield which are usually present in *E. antiquorum* L., *E. caducifolia* Haines, *E. cattimandoo* Elliot ex Wight (endemic), *E. neriifolia* L., *E. nivulia* Buch.-Ham., *E. royleana* Boiss., *E. santapaui* A.N.Henry (endemic), *E. susan-holmesiae* Binojk. & Gopalan, *E. tortilis* Rottler ex Ainslie (Endemic), *E. vajravelui* Binojk. & N.P.Balakr. (endemic), but absent in *E. epiphylloides* Kurz (endemic) and geophytes (*E. fusiformis* Buch.-Ham. ex D. Don, *E. khandallensis* Blatt. & Hallb. (=*E. panchganiensis* Blatt. & McCann) (endemic), *E. nana* Royle (endemic), *E. meenae* S. Carter (endemic)). During the last decade, 6 new species and one new variety have been published from India in the section *Euphorbia* viz, *E. seshachalamensis* K.Prasad & Prasanna, *E. belagaviensis* Sarojin. & Raja Kullayisw., *E. gokakensis* S.R.Yadav, Malpure & Chandore, *E. venkatarajui* Sarojin., *E. vajravelui* var. *theniensis* B.DeJong & R.W.Stewart, *E. lakshminarasimhanii* Malpure, Chandore, P.S.Raut & B.DeJong and *E. sahyadrica* Sardesai & Malpure.

The new *Euphorbia* species is most similar to *E. caducifolia*, but it significantly differ in certain characters and deserved to be recognized as a distinct species.

TAXONOMIC TREATMENT

Euphorbia ravii A.Naray. & K.Prasad, ***sp. nov.***

Figs. 1–**3**

Type: INDIA, Andhra Pradesh, Ananthapuramu district, Old Pulivendula Ghat road, 530 m, 11th May 2014, *A. Narayana Swamy 44906* (holo: SKU, iso: SKU).

Diagnosis: This species is similar to *Euphorbia caducifolia* Haines but differs in its slightly winged and subterete stems (vs. terete stems), conical podaria (vs.

Fig. 1. ***Euphorbia ravii*** A.Naray. & K.Prasad, sp. nov. **A**. Habit; **B**. Young branches; **C**. Mature branches; **D**. Young spines; **E**. Mature spines; **F**. Leaves with young spines.

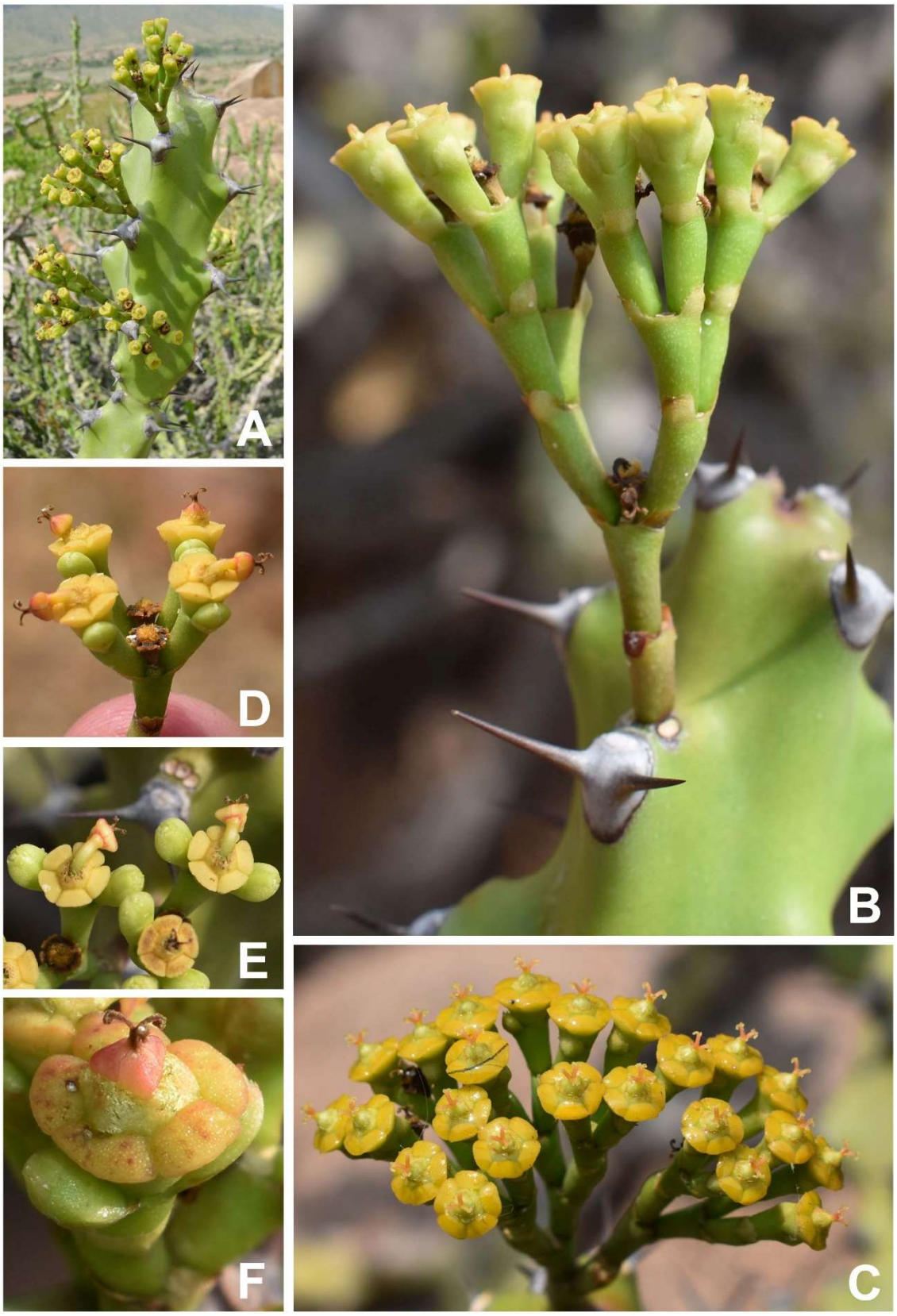

Fig. 2. ***Euphorbia ravii*** A.Naray. & K.Prasad, sp. nov. **A**. Inflorescence branch; **B** & **C**. Cyathia; **D**. Dichotomously branched cymes; **E**. Involucres; **F**. Glands surface pitted.

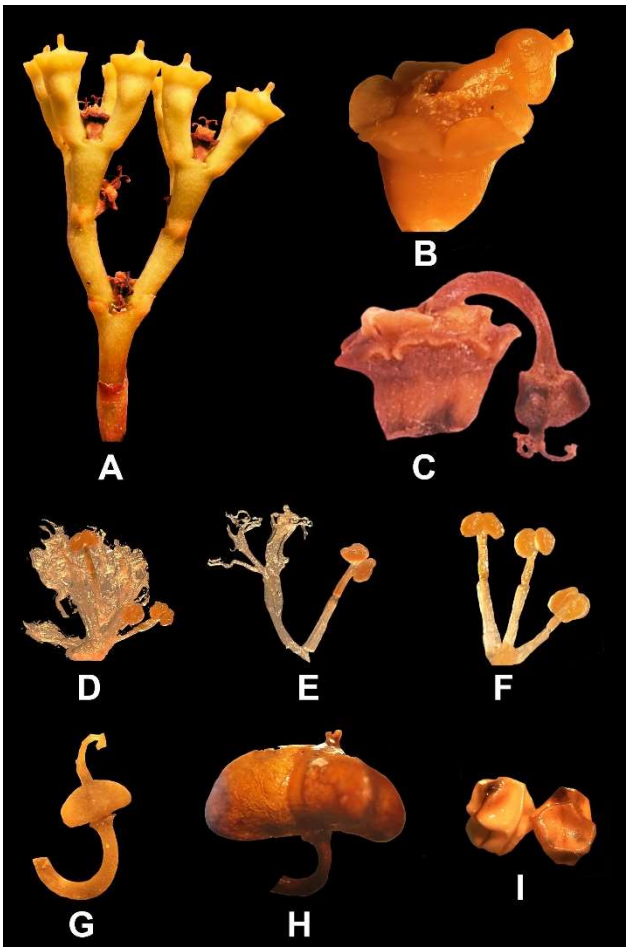

Fig. 3. ***Euphorbia ravii*** A.Naray. & K.Prasad, sp. nov. **A**. Dichotomously branched cyme; **B** & **C**. Involucre; **D**. Staminate flowers in fascicle; **E**. Staminate flower with bracteoles; **F**. Staminate flowers; **G**. Pistillate flower; **H**. Capsule; **I**. Seeds.

rounded), broadly ovate leaves with truncate or rounded base (vs. variable, ovate, ovate-elliptic to orbicular, with cuneate base), up to six times dichotomously branching cyathial cymes (vs. triads or fascicles), margins of bracts irregularly serrate (vs. entire), cupular involucre (vs. turbinate), seeds with large rounded to sub-rounded pits (vs. without pits).

Description: Shrubs, about 2.4 m high; stems succulent; branches arising from the base, ascending, much branched, angular or irregularly angular or subcylindrical, spiny, with extended podaria, green or pale green with silvery white coating. Podaria conical, 1–1.2 cm long (base 1 cm wide and narrower upwards), spirally arranged, spiny at the tip; spine shield 6–8 mm in diameter, conical or discoid, distinct, brownish when young becoming ash grey; spines in pairs, divergent, rigid, 0.3–0.6 cm long, reddish when young, later ash grey becoming blackish when mature. Leaves 1.5–4 × 1–2 cm, fleshy, sessile, broadly or narrowly ovate, acute at apex, truncate or rounded at base, entire or serrate along the margins, caducous; prominent mid-nerve and indistinct lateral nerves. Cyathia in axillary, dichotomously branched cymes, solitary or paired or 3; cymes branching up to 6 times, central one sessile and lateral two pedunculate, greenish-yellow. Primary peduncle short, 4–7 mm long, fleshy, greenish-yellow or reddish-green; bracts 2, opposite, 1.6–2 × 1.7–2 mm, triangular, acute at apex, irregularly serrate along the margins. Involucre 3–4 × 2.5–3 mm, cupular; lobes 5, broadly cuneate, fimbriate at apex; glands 5, 2–2.5 mm long, transversely oblong, upper surface pitted. Staminate flowers: in 5 fascicles, 3 to 9 flowers each; pedicels about 1.5 mm long; anthers ellipsoid to subglobose; bracteoles covering flowers, 1.9–2.1 mm long, laciniate at apex. Pistillate flower: gynophore 5–7 mm long, curved; perianth lobes 3, minute, triangular; ovary trigonous; styles connate to the middle; stigma bi-lobed, papillose. Capsules trilobed, with laterally compressed and obtusely keeled cocci, 6–8 mm in diameter, becoming reddish at maturity; seeds subglobose or ellipsoid, brownish, with large rounded to sub-rounded pits.

Flowering & Fruiting: February-May.

Habitat: It is found growing between granite rocks on small hills in scrub forest, at elevation range of 255–262 m. Its common associates are *Euphorbia antiquorum* L., *E. caducifolia* Haines, *Cymbopogon coloratus* (Hook.f.) Stapf., *Gyrocarpus americanus* Jacq., *Alangium salviifolium* (L.f.) Wangerin and *Wrightia tinctoria* R.Br.

***Distribution*:** *Euphorbia ravii* is known from the type locality in the Ananthapuramu district, Deccan Plateau, Andhra Pradesh, India.

Etymology: The new species named in honour of Dr. B. Ravi Prasad Rao, Professor of Botany at Sri Krishnadevaraya University, Ananthapuramu, India for his contributions to the flora of Andhra Pradesh, Eastern Ghats and Andaman & Nicobar Islands.

Preliminary conservation status: The new species, *Euphorbia ravii* has a restricted distribution with about 20 individuals and spreading about 2 km^2 in one population. The present habitat is highly threatened due to granite mining (all individuals were observed in this area only) and seasonal/anthropogenic forest fires. Many explorations were made in the adjacent habitat but populations of the species could not be located. Based on 'Extent of Occurrence' (Criterion B1: EOO < 100 km^2) and 'Area of Occupancy (Criterion B2: AOO < 10 km^2) together with the distributed in single location (subcriterion 'a') and projected decline in area, extent and/or quality of habitat (subcriterion 'b(iii)'), the new species is assessed here as 'Critically Endangered [CR B1 B2 a, b(iii)]' (IUCN 2019). Interestingly, the convention on international trade in endangered species of wild fauna and flora (CITES) regulations protect about 850 succulent species of *Euphorbia* (Carter and Eggli, 2003).

Additional specimens (Paratypes): INDIA. Andhra Pradesh: Ananthapuramu district, Old Pulivendula Ghat, 542 m, 26 April 2015, *A. Narayana Swamy & K. Prasad 44958* (SKU); 522 m, 22 May 2016, *A. Narayana Swamy & K. Prasad 45002* (SKU), 535 m, 3 June 2017, *A. Narayana Swamy & K. Prasad 45072* (SKU).

Table 1. Comparative morphology between ***Euphorbia ravii***, ***E. caducifolia***, ***E. belagaviensis***, ***E. venkatarajui*** and ***E. gokakensis***.

Character	***E. ravii***	***E. caducifolia***	***E. belagaviensis***	***E. venkatarajui***	***E. gokakensis***
Habit	Not dwarfed, no compact stems	Not dwarfed, no compact stems	Not dwarfed, no compact stems	Dwarf, forming compact cushions	Dwarf, forming compact cushions
Height (m)	Up to 2.4	Up to 2.5	Up to 2.5	Up to 1	Up to 0.5
Stem Branches	Angular or irregularly angular or subcylindrical	Terete throughout	Slightly winged	Terete throughout	Terete, tapering towards apex
Podaria					
Shape	Conical	Rounded	Conical to elongate conical	Conical	Conical
Size (cm long)	1–1.2	0.7	1.2	1–1.2	0.4–0.5
Leaf					
Shape	Broadly or narrowly ovate	Ovate, ovate-elliptic to orbicular	Obovate-spathulate	Obovate	Ovate, obovate or ovate-oblong
Base	truncate or rounded	cuneate	narrowed	rounded	narrowed
Size (cm long)	1.5–4	2–8	0.8–0.9	0.6–0.8	1.2–3
Cyathia nature	Cymes branching up to 6 times in dichotomously	Triads or fascicles	Cymes branching 2 or rarely 3 times in dichotomously	Triads clusters or fascicles	Fascicles
Cyathia colour	Greenish-yellow	Pinkish red or reddish pink	Yellowish to pink	Yellowish to pink	Yellowish
Involucre	Cupular	Turbinate	Cupular	Cupular	Turbinate
Bracts margins and apex	Irregularly serrate, acute	Entire, acuminate	Entire, acuminate	Entire, acuminate	Entire, acuminate
Stigma	Perfectly bi-lobed	Minutely bilobed	Not lobed	Not lobed	Bi-lobed
Seeds	Pitted	Not pitted	Not pitted	Not pitted	Not pitted
Distribution	India (Pulivendula Ghat road, Ananthapuramu district, Andhra Pradesh)	India (Andhra Pradesh, Bihar, Chhattisgarh, Gujarat, Karnataka, Madya Pradesh, Maharashtra, Odisha, Rajasthan, Telangana) & Pakistan	India (Gokak, Belagavi district, Karnataka)	India (Yaganti, Kurnool district, Andhra Pradesh)	India (Gokak, Belagavi district, Karnataka)

***Note*:** The *Euphorbia caducifolia* group consists of 4 species in India and all with succulent habit and spine-shield. However, all these species were found to have their own diagnostic features and are clearly distinct from present new species, *E. ravii* (Table 1). This new species is easily distinguishable by the up to six times dichotomously branching cyathial cymes and pitted seeds, these characters that are very rare in the genus.

This group is mainly distributed in Indian subcontinent (India & Pakistan) and mostly grows in dry habitats of tropical scrub or open forests and rock outcrops. Only one species *Euphorbia caducifolia*, is commonly widespread in dry habitats of India (Andhra Pradesh, Bihar, Chhattisgarh, Gujarat, Karnataka, Madya Pradesh, Maharashtra, Odisha, Rajasthan, Telangana) and relatively rare in Pakistan. The remaining 4 species (including present new species) are found to be habitat specific and endemic to their type localities in Deccan plateau of India. Two species, *E. belagaviensis* and *E. gokakensis*, are endemic to scrub forest and open rocky hillocks of Gokak in Karnataka and remaining species, *E. venkatarajui* and *E. ravii* sp. nov. are endemic to dry parts of Kurnool and Ananthapuramu districts of Andhra Pradesh (Fig. 4).

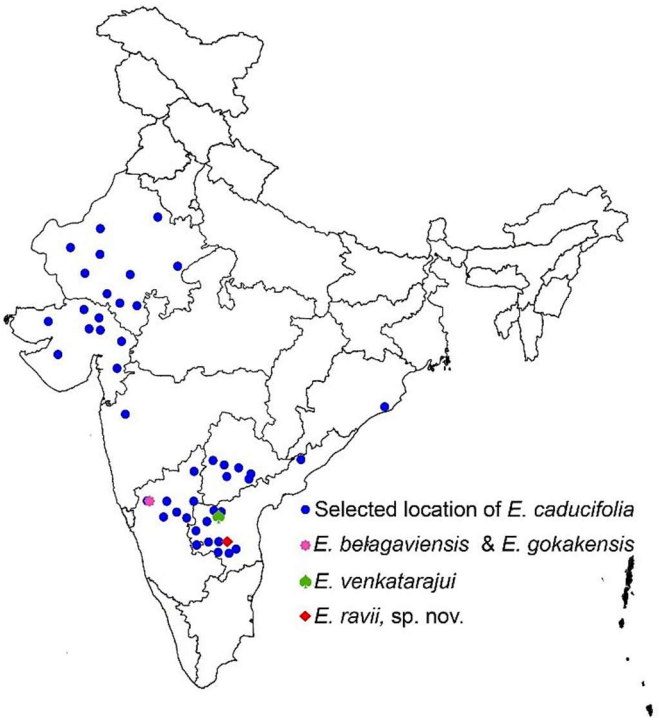

Fig. 4. Distribution map of ***Euphorbia caducifolia*** group in India.

Key to the *Euphorbia caducifolia* group in India:

1a. Plant compact cushion like, 0.5–1 m high ……..……..……2
1b. Plant not cushion like, about 2.5 m high ……..……..…… 3
2a. Plant up to 1 m high; leaves less than 1 cm long, rounded or acute at apex; involucre cupular; cocci curved, obtusely keeled ……..…… ……..…… ***E. venkatarajui***
2b. Plant up to 0.5 m high; leaves more than 1 cm long, cuspidate at apex; involucre turbinate; cocci recurved, acutely keeled ……..…… ……..…….. ***E. gokakensis***
3a. Stem branches twisted; primary peduncle more than 10 mm long; style free, simple at apex ……..…….. ***E. belagaviensis***
3b. Stem branches not twisted; primary peduncle less than 8 mm long; style connate at base, bifid at apex ……..…….. 4
4a. Podaria rounded; cymes in triads or fascicles; bracts acuminate at apex; seeds not pitted ……..….. ***E. caducifolia***
4b. Podaria conical; cymes up to six times dichotomously branched; bracts acute at apex; seeds pited …….. ***E. ravii*** sp. nov.

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