



Contribution to the Flora of Dihang Dibang Biosphere Reserve, India-I

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ABSTRACT: This paper deals with two new species viz. *Anemonastrum teetapurense* Bhaumik & G. Krishna.; *Callianthemum pathakii* G. Krishna & Bhaumik and one new combination *Anemonastrum obtusilobum* (D. Don) Mosyakin, subsp. *leiophylla* (W.T. Wang) Bhaumik & G. Krishna. *Beesia deltophylla* C.Y. Wu reported first time from India. All taxa belong to the family Ranunculaceae.

KEY WORDS: *Anemonastrum teetapurense*, *Callianthemum pathakii* Northeastern India, Ranunculaceae, new combination.

INTRODUCTION

Dihang Dibang Biosphere Reserve (here after, DDBR), located on extreme north-east corner of India, spread over four districts of the state Arunachal Pradesh, namely Dibang Valley, Upper Siang, East Siang and West Siang. It was established on 2nd September, 1998 with a total area of 5115.5 sq. km. Out of this 4094.80 sq. km. from the core zone and remaining 1016.70 sq. km. from buffer zone. The topography of DDBR is very diverse; it is one of the most difficult terrains in Arunachal Pradesh, India. The area is highly rugged with stiff slopes and deep gorges and an altitudinal range varies from 500 m to over 6000 m. The lower hills represented by dense evergreen forests and a large number of rivers and rivulets. Due to inaccessibility of the area, plant diversity very poorly studied.

MATERIAL AND METHODS

To document the phyto-diversity of DDBR, intensive and extensive field surveys were undertaken periodically in various flowering and fruiting seasons to different habitats in 1995–2015. A total of eighteen field exploration were conducted and over 15000 specimens were collected. The duration of each field survey ranged between 28 and 60 days.

The specimens were dried, processed and mounted following conventional methods (Jain and Rao, 1977). In due course of identification work, few specimens looks different from known species of Ranunculaceae. On perusals of relevant literature Hooker and Thomson (1872); Bruehl (1892); Handel-Mazzetti (1931); Tamura (1962); Rao and Joseph (1965); Holub (1973); Grierson (1984); Ziman and Keener (1989); Rau (1993); Wang *et al.* (2001); Mudgal *et al.* (2002); Choudhary (2008); Bhaumik (2014); Mosyakin and Lange (2018); Ziman *et al.* (2007) and including types and protologue of

morphologically most similar species available in various herbaria (ARUN, ASSAM, BSHC, BM, CAL) and virtual herbarium specimens (E, K, NY, P, PE) were consulted to assess the existing recorded species. After confirming the novelty of the species belonging to the family Ranunculaceae under the genus *Anemonastrum* Holub and *Callianthemum* C.A. Mey., the need to describe as new species, and a new combination and two new distributional record for India.

TAXONOMIC TREATMENT

Anemonastrum teetapurense Bhaumik & G. Krishna *sp. nov.* **Figs. 1–3**

Type: India, Arunachal Pradesh, Upper Siang, Ruitala-Ekodumbing mountain top (N 28°43.189' E 95°10.610'), 3340–3950 m, 23 Jul. 2010, Pathak & Bhaumik 73057 (Holotype CAL; Isotype: BSIS).

Diagnosis: This new species *Anemonastrum teetapurense* is very close to *A. demissum* (Hook. f. & Thomson) Holub (1973), but differs in leaves 3–5 partite, reniform-orbicular in outline, wider than long, 3–6 × 5–7 cm, segments not petiolulate (vs. lamina 3-sect, ovate, broadly so, rhombic-pentagonal, or reniform-pentagonal in outline, not wider than long, 5–8 × 4–6(–12) cm); scape erect, 20–50 cm long, villous (vs. decumbent, 15–45(–80) cm, spreading villous); flowers 1–2 cm across (vs. c. 2.6 cm across); petals yellow (vs. blue, purple, red, or white); pedicels elongate at maturity (vs. not elongate at maturity); achene obovate (vs. ellipsoid or obovoid); style hooked (vs. curved) (**Table 1**).

Description: Perennial, rhizomatous herbs; rhizome stout, erect, cylindrical, 1–1.5 cm in diameter. Stems reduced, indistinct, simple, erect. Leaves 10–20, mostly basal or located at lower part of stem; lamina 3–5-partite, reniform-orbicular in outline, wider than long, 3–6 × 5–7 cm, densely golden brown villous on both surfaces, lower surface more densely villous; each part of lamina obovate,



Table 1: Comparison of diagnostic characters of *Anemonestrum teetapurense* Bhaumik & G. Krishna; *A. demissum* (Hook.f. & Thomson) Holub; *A. narcissiflorum* (L.) Holub

Characters	<i>A. teetapurense</i>	<i>A. demissum</i>	<i>A. narcissiflorum</i>
Leaves	3–5-partite, reinform-orbicular in outline, wider than long, 3–6 × 5–7 cm, segments not petiolate	3-partite; orbicular, 2.5 cm across, segments petiolate	3-partite, pentagonal suborbicular, or orbicular-ovate, 3–7 × 4–12 cm, segments petiolulate or subsessile
Scape	erect, 20–50 cm long, villous	decumbent, 15–40 cm, spreading villous	erect, 10–50 cm, villous or sparsely puberulent
Flower	yellow, 1–2 cm across	blueish, c. 2.6 cm across	white or yellowish, rarely pinkish, c. 2 cm across
Pedicels	elongate at maturity	not elongate at maturity	not elongate at maturity
Achenes	obovate; style hooked	orbicular; style deflexed	obovoid; style hooked



Fig. 1. *Anemonestrum teetapurense* Bhaumik & G. Krishna in its natural habitat and closeup of flower (photo by M. Bhaumik; Plate prepared by Sauvik Roy).

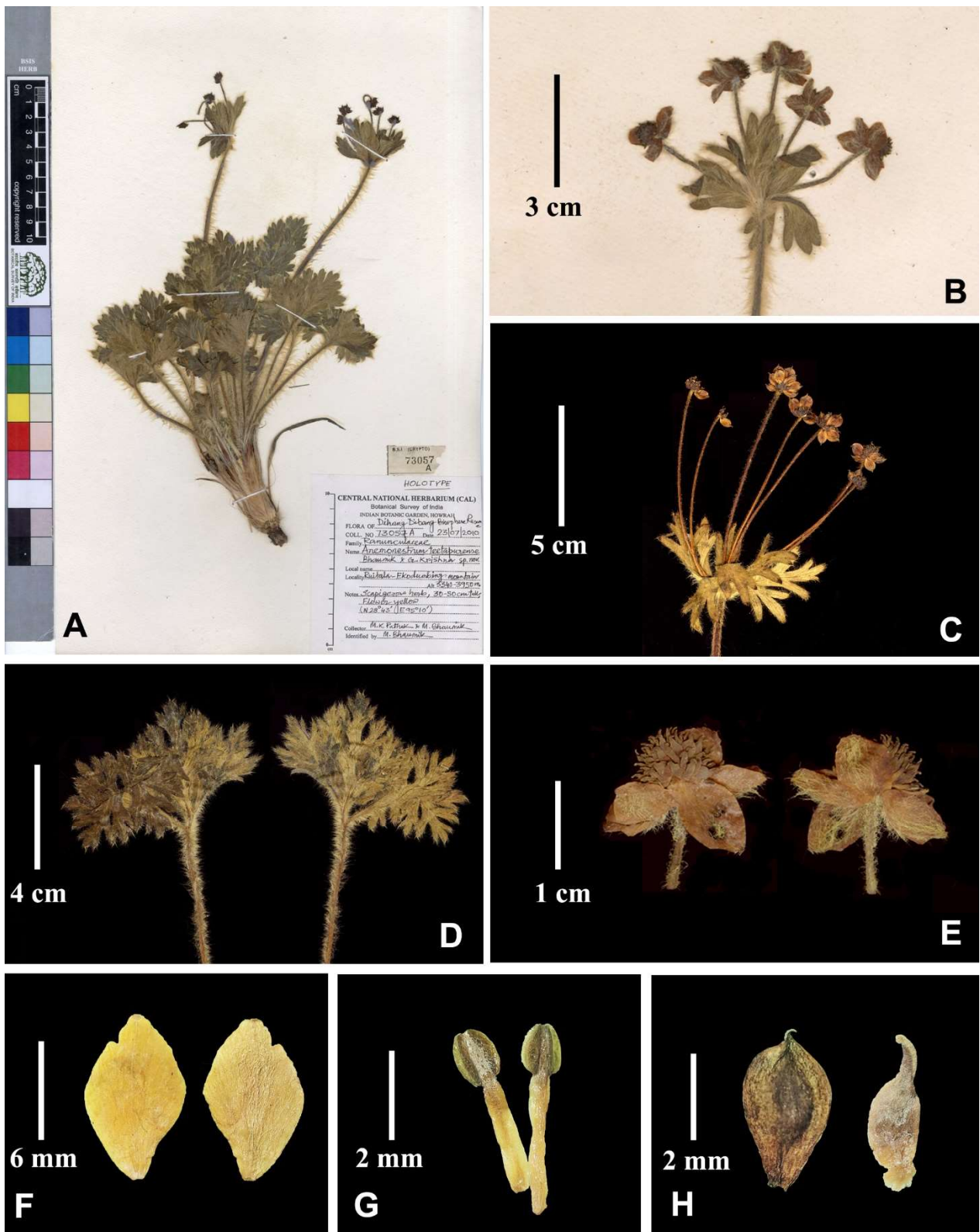


Fig. 2. *Anemonestrum teetapurense* Bhaumik & G. Krishna A. holotype; B. close up of inflorescence from holotype; C. mature inflorescence (from Paratype Pathak & Bhaumik 73474A); D. leaf dorsal and ventral side; E. flower; F. sepal dorsal and ventral view; G. stamens; H. mature achene (Plate prepared by Sauvik Roy).

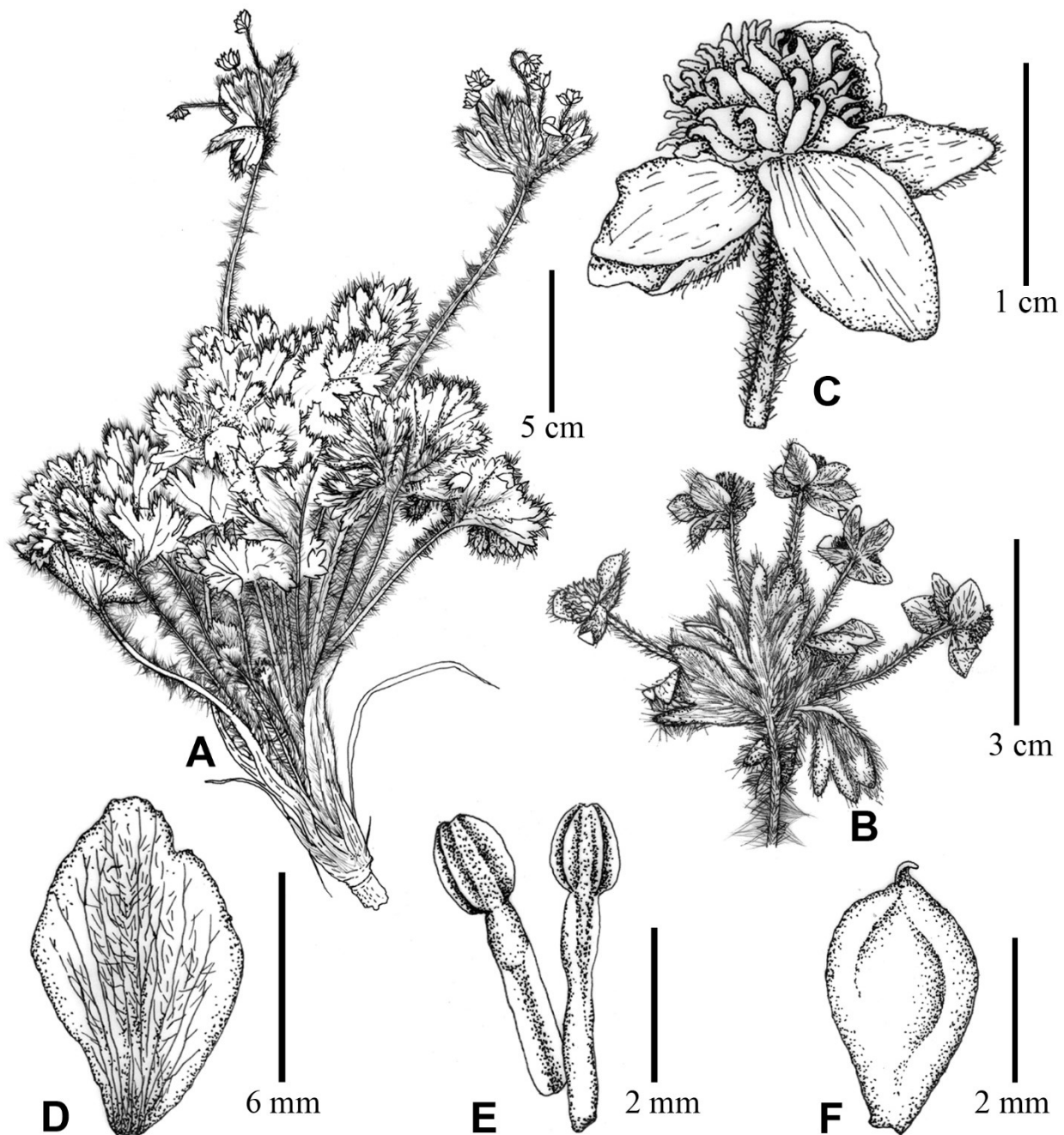


Fig. 3. *Anemonestrum teetapurensis* Bhaumik & G. Krishna **A.** habit; **B.** inflorescence; **C.** flower; **D.** petal; **E.** stamens; **F.** mature achene (drawn by Sauvik Roy from type materials).

3–5-lobed towards apex, ultimate lobe oblong, acute to apiculate, margin ciliate. Petioles 8–30 cm long, golden-brown villous all along; base sheathing, 2–6 × 1–1.5 cm. Scapes axillary, 1–3, 20–50 cm long, terete, villous. Involucre bracts 3, similar to leaves but smaller. Flowers 3–6 per simple umbel; pedicel 2.5–3.5 cm long, golden-brown villous, elongated up to 10 cm at maturity. Flowers 1–2 cm in diameter. Sepals 5, petaloid, yellow, villous outside, broadly ovate 8–10 × 5–7 cm, acute to rounded

at apex. Stamens 15–20, 4–5 mm long; filament flat broader towards apex; anther *c.* 1 mm long, oblong, basifixed. Ovary elliptical, 1.5–2 mm; style short. Carpels numerous, 40–60, only few matured. Mature achene bilaterally flattened, broadly winged, elliptic-obovate, 5–7 × 2.5–4 mm, style persistent very short, curved.

Flowering & Fruiting: July–October.

Etymology: The specific epithet derives from its place of occurrence, Teetapuri. The home of *Coptis teeta* Wall.

**Table 2:** Comparison of diagnostic characters of *Callianthemum pathakii* G. Krishna & Bhaumik and *C. pimpinelloides* (D. Don) Hook. f. & Thomson.

Characters	<i>C. pathakii</i>	<i>C. pimpinelloides</i>
Habit	scapigerous; stems absent; scape simple, solitary	scapigerous or not; stems 2 or 3, unbranched or 1–2-branched
Leaves	basal leaves fully expanded at anthesis; leaflet ternate; obovate, 5–10 × 5–8 mm, apex shortly 3-lobed, margin entire not undulate, upper surface setose; leaflet shortly petiolulate,	basal leaves not fully expanded at anthesis; lateral leaflets 1–3 pairs; ovate to narrowly ovate, 1.5–2.5 × 1.4–1.8 cm, apically flabellate to rhombic, deeply undulate margin with obtuse teeth, upper surface glabrous; leaflets subsessile
Bracts	3, elliptic, 4–6 × 1.5–2 mm	absent
Sepals	obovate, 5–5.6 × 3–4 mm, apex rounded, base narrowed	elliptic, 3–6 × 1.8–3.5 mm, apex obtuse to acute, base scrotiform
Petals	(4–) 5 white, elliptic–oblanceolate to spatulate, 5.8–6.2 × 1.8–2.2 mm, apex acute	5–7(–9), white, pink or pale purple, obovate-oblong to broadly linear, 5–10 × 1–2.5 mm, apex rounded
Stamens	4–8; filament flat, short not linear-lanceolate; anther linear	many; filaments lanceolate-linear; anthers ellipsoid
Achene	15–20, ellipsoid-ovoid, smooth	8–14, ovoid, rugose

Conservation Status: The new species collected made from four localities and more than 200 mature individuals were traced. The population status has been assessed thoroughly and the Area of occupancy (AOO) and Extent of occurrence (EOO) has been calculated from the GeoCAT website (<https://geocat.iucnredlist.org/>). The AOO is 16.000 km² and EOO is 28.627 km² respectively. The species meets the EN category of the IUCN Red List following B2 c ii of the five criteria of evaluating species (IUCN, 2024). This species grows in a conserved site and far away from human habitation, so, no immediate threats for extinction in the wild.

Other specimen examined: India, Arunachal Pradesh, Upper Siang, Pavo-Teetapuri camp (N29°57' & E 95°15'), 3650–4500 m, 10 Sep. 2009, *Pathak & Bhaumik 73474* (73474A-D, CAL; 73474E, BSIS); Pemashree proper, 4000–4500 m, 12 Sep. 2011, *Pathak & Gopal Krishna 54329* (CAL); Pavo to Psonga & Teetapuri (Psonga N28°58.916', E95°14.347'; Teetapuri N28°57.990', E95°14.980'), 3700–4500 m, 07 Aug. 2012, *Pathak & Gopal Krishna 54580* (CAL).

***Callianthemum pathakii* G. Krishna & Bhaumik sp. nov.**

Figs. 4 & 5

Type: India, Arunachal Pradesh, Upper Siang district, Pavo to Teetapuri, 3700–4500 m, 7 Aug. 2012, *Pathak & G. Krishna 56521* (Holotype & Isotype CAL).

Diagnosis: This new species is closely allied to *Callianthemum pimpinelloides* (D. Don) Hook. f. & Thomson but differs by ternate leaf (vs. 2–3-pairs of lateral leaflet); upper surface of lamina setose (vs. glabrous); leaflet shortly petiolulate (vs. subsessile); petioles 2.5–4.5 cm (vs. 1.5–6 cm); sepals obovate, 3–4 mm wide (vs. elliptic, 1.8–3.5 mm wide); petals elliptic–oblanceolate to spatulate (vs. obovate-oblong to broadly linear); stamens 4–8, c. 3 mm long (vs. many, 2.5–5 mm long); achene 15–20, ellipsoid-ovoid, few silky hairs at base (vs. 8–14, ovoid, glabrous, rugose (Table 2)).

Description: Perennial herb, 6–12 cm high; rootstock covered with old fibrous sheaths. Stems absent. Scape simple, solitary, glabrous. Leaves 2–5, basal, ternate, petiolate, each leaflet shortly petiolulate, obovate, 5–10 × 5–8 mm, apex shortly 3-lobed, upper surface dark green, setose, lower paler, glabrous; petioles 2.5–4.5 cm long, glabrous, sheaths narrow, white towards base.

Inflorescence terminal, solitary flowered on scape; scape up to 10 cm tall, glabrous. Bracts 3, located at base of pedicel, elliptic, 4–6 × 1.5–2 mm, acute to rounded, glabrous, occasionally lobed. Sepals white, 5, obovate, 5–5.6 × 3–4 mm, apex rounded, base narrowed, membranous, glabrous, basal nerve 5. Petals white, (4–) 5, elliptic–oblanceolate to spatulate, 5.8–6.2 × 1.8–2.2 mm, acute, glabrous, narrower, longer than sepals, 3-nerved, membranous. Stamens 4–8, c. 3 mm long, filament flat, c. 2.2 × 0.5 mm; anther linear, c. 1 mm, glabrous. Receptacle globose, glabrous. Achene 15–20, smooth, ellipsoid-ovoid c. 3 × 1 mm, few silky hairs at base; style subulate curved at apex.

Flowering & Fruiting: June–August.

Etymology: The species is named after Late Dr. M. K. Pathak, Botanist, explorer of India, for his significant contribution to Dihang Dibang Biosphere Reserve (DDBR), Arunachal Pradesh, India.

Conservation Status: The newly described species *Callianthemum pathakii* G. Krishna & Bhaumik has been collected and described from Upper Siang valley of Arunachal Pradesh. Until now, the new species is reported from two populations with more than 50 mature individuals. The Area of occupancy (AOO) and Extent of occurrence (EOO) has been calculated from the GeoCAT website (<https://geocat.iucnredlist.org/>). The AOO is 8 km² and EOO is 0 km² respectively. The species meets the CR category of the IUCN Red List following B2 c ii. (IUCN 2024). This species grows in a conserved site and far away from human habitation, so, no immediate threats for extinction in the wild.

The treatment of *Anemone* spp., under different subgenus, section and series have a long history and opinion varies greatly. Holub (1973) try to categorized more homogenous group by establishing different genera from heterogenous *Anemone* L. *Anemonastrum* Holub characterized by vertical short rhizome, glabrous, strongly laterally compressed winged achene. Based on these characters and studies on our own collections *Anemone obtusiloba* subsp. *leiophylla* W.T. Wang, better suited under *Anemonastrum* Holub. So, a new combination has been proposed below.

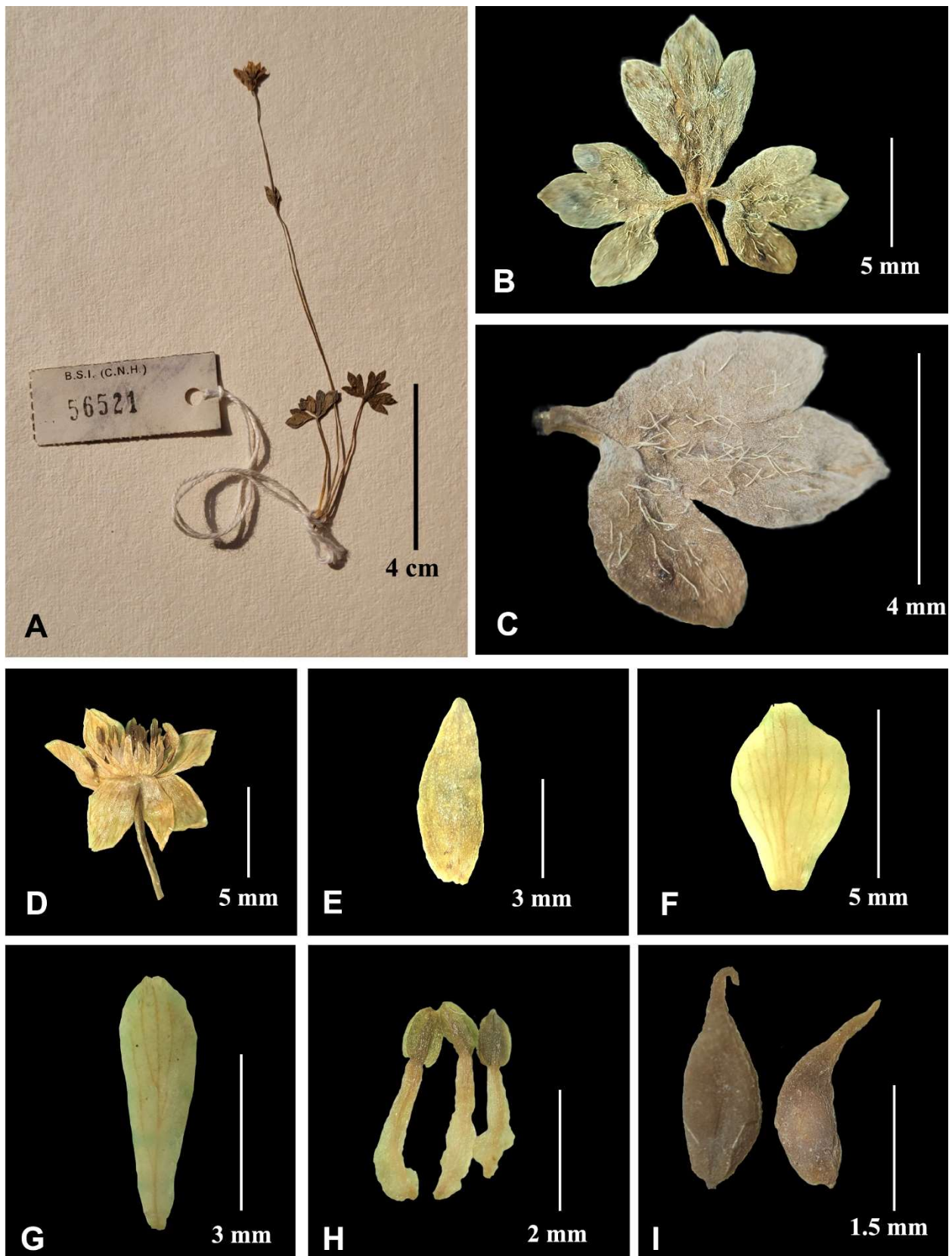


Fig. 4. *Callianthemum pathakii* G. Krishna & Bhaumik A. habit; B. leaf blade; C. dorsal view of leaflet; D. flower; E. bract; F. sepal; G. petal; H. stamens; I. achene (prepared by Sauvik Roy from Pathak & G. Krishna 56521).

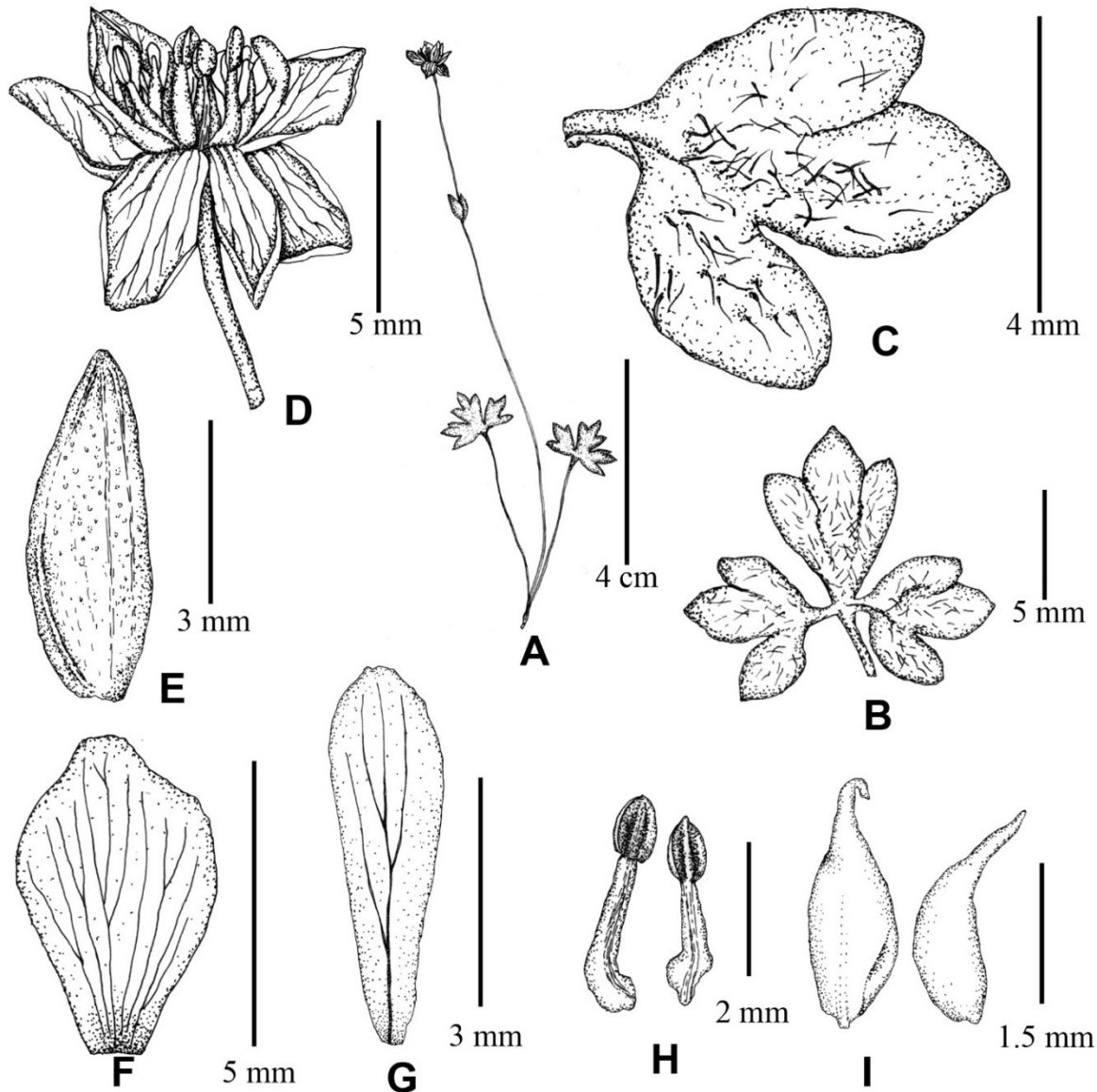


Fig. 5. *Callianthemum pathakii* G. Krishna & Bhaumik. A. habit; B. leaf blade; C. dorsal view of leaflet; D. flower; E. bract; F. sepal; G. petal; H. stamens; I. achene (drawn by Sauvik Roy from type materials).

Anemonastrum obtusilobum (D. Don) Mosyakin, subsp. *leiophylla* (W. T. Wang) Bhaumik & G. Krishna, **comb. nov.**

≡ *Anemone obtusiloba* subsp. *leiophylla* W. T. Wang, Fl. Reipubl. Popularis Sin. 28: 350. 1980.

≡ *Anemone obtusiloba* var. *leiophylla* (W. T. Wang) Ziman, Ehrend. & Bulakh, Edinburgh J. Bot. 64(1): 64. 2007.

Type: China, Yunnan, Kungshan, 3000ft, 07-12-1938, T. T. Yu 22076 (holotype PE00026907!); Mons inter flumina Nuchiang & Kiuchiang, 2900m, 09-07-1937, T. T. Yu 19268 (Paratype: PE00383947 image!)

Description: Perennial scapigerous herbs. Leaves 3–7, basal; lamina 3-lobed up to base, reniform-pentagonal to broadly ovate, 2–6 × 2–8 cm, base cordate, rarely truncate, scattered pubescent; each lobe not overlapping, 3-parted up to middle, obovate, c. 2.5 × 2 cm, cuneate at

base incised towards apex and upper margin; petioles 3–15 cm long, pubescent, occasionally glabrous. Scape 2–5, up to 20 cm long, glabrous or minutely pubescent. Flowers 1–2, c. 2.5 cm in diameter; pedicels 1–5 cm, glabrous or minutely pubescent. involucre bract blade 3-dentate or undivided, glabrous. Sepals white, 5, elliptic to obovate, 7–15 × 5–8 mm, abaxially pilose, veins 3–5. Stamens many, 2.2–3 mm long; filaments linear; anthers ellipsoid, connective narrow. Ovary ovoid, villous; style straight or curved. Achene broadly ovoid, 3–5 × 2–3 mm, without ribs, densely strigose.

Flowering & Fruiting: June–August.

Notes: This taxon is known from South-Central China (POWO, 2024). Present collection from India represents new distributional record for India.



Specimens examined: India, Arunachal Pradesh, Upper Siang, Kanebango-Pavo camp, 3400–4500 m, 06.08.2012, Pathak & Gopal Krishna 54547 (CAL); Upper Siang, Kanebango-Pavo camp, 3400–4500 m, 06.08.2012, Pathak & Gopal Krishna 54555 (CAL).

Beesia deltophylla C.Y. Wu, Fl. Reipubl. Popularis Sin. 27: 604. 1979. **Fig. S1**

Description: Scapigerous herb, 15–43 cm high. Basal leaves 2–3, ovate-triangular, 6.5–11 × 5–8 cm, base deeply cordate, margin sparsely 7–16-dentate on each side, apex acuminate, upper surface dark green, lower paler, glabrous on both surfaces; petioles 10–20 cm long, densely spreading white pubescent. Scape 20–40 cm long, erect, pilose towards apex, racemosely arranged few flowered panicles. Flowers 6–7 mm in diameter; pedicels 5–10 mm long, densely spreading pubescent; bracts subulate, 1–4 mm long. Sepals white, ovate-elliptic, 4–4.5 × 2–2.5 mm, acute, glabrous. Stamens many, shorter than sepals. Follicles lanceolate, c.10 mm long, flat, sparsely pubescent; seeds many, obliquely corrugate.

Flowering & Fruiting: July–September.

Notes: In India, the genus was previously represented by only species *Beesia calthifolia* (Maxim. ex Oliv.) Ulbr. (Tiwari, 2016). *Beesia deltophylla* C.Y. Wu, so far known from SE. Tibet (POWO, 2024) and present collection from Arunachal Pradesh is new addition to Flora of India.

Specimens examined: India, Arunachal Pradesh, Upper Siang, Singa to Sitoma, 1500–2400 m, 21.07.2010, Pathak & Bhaumik 72901 (CAL); Upper Siang, Sitoma to Pemashree, 2370–4000 m, 11 Sep. 2011, Pathak & Gopal Krishna 54264 (CAL).

Key to the species of *Beesia* in India

- 1a. Basal leaves ovate-triangular; petioles 10–20 cm long, densely spreading white pubescent; follicles lanceolate, c.10 mm long *B. deltophylla*
- 1b. Basal leaves reniform, orbicular-ovate; petiole (5.5–)10–26 cm, slightly widened, glabrous; follicle lanceolate-linear, 1.1–1.7 cm long *B. calthifolia*

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