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Note

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Extended distribution record of two bellflower species of *Codonopsis* (Campanulaceae) from the Indian state of Arunachal Pradesh

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The genus *Codonopsis* Wall. (Campanulaceae) consists of about 42 species, widely distributed in tropical and temperate to alpine regions of Asia and Europe (Haridasan & Mukherjee 1996; Hong 2015). In India, the genus is mainly distributed in temperate, sub-alpine, and alpine regions of the Himalaya. The name *Codonopsis* was given by Wallich (1824). Derived from the Greek word 'kodon/ codon' meaning bell and the Latin suffix '-opsis' used to indicate resemblance, the name refers to the shape of its flower, which is similar to that of a bell. Among the *Codonopsis* species, *C. pilosula* (Franch.) Nannf. and *C. lanceolata* (Sieb. et Zucc.) Benth. & Hook. f. ex Trautv. are more popular than the others, especially due to their phytochemical activities (He et al. 2015). According to Kala (2010), *C. clematidea* (Schrenk) Cl., *C. ovata* Benth., and *C. rotundifolia* Benth of the western Himalaya are used in indigenous medicine by 'amchis' for curing skin diseases. "Sowa-Rigpa" commonly known as amchi system of medicine is one of the oldest living and well documented medical tradition of the world. It has been popularly practice in Tibet, Magnolia, Bhutan, some parts of China, Nepal, Himalayan regions of India and few parts of former Soviet Union.

A survey was carried out in Tawang District of Arunachal Pradesh during 2016–2017 for the assessment of the floral diversity of high altitude areas. *Codonopsis foetens* and *C. thalictrifolia* were collected from Kyo Tso Wetlands (27.696^{0}N & 91.842^{0}E, 4,245m) and Nagula Tso Wetlands (27.654^{0}N & 91.863^{0}E, 4,070m), respectively. These two species of *Codonopsis* are very rare and endemic to the eastern Himalaya and have a limited distribution in Sikkim, Bhutan, and China. The Nagula Wetland complex area is rich in high altitude floral diversity and is little explored at present. The identification of the species was confirmed through consultation of type specimens and the protologue of the species. Further consultation of important literature (Clarke 1882; Haridasan & Mukherjee 1996; Chowdhery et al. 2008; Pal 2013; Tiwari 2015–2016; Dash & Singh 2017) and of herbarium at various institutions, such as the Botanical Survey of India, Itanagar (ARUN), the State Forest Research Institute (SFRI), Itanagar, and the Royal Botanic Gardens, Kew (K), United Kingdom, were done for the identification of the species and the gathering

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of information on their historical distribution. These sources revealed that the species were not reported earlier from Arunachal Pradesh and that, in India, these were known from Sikkim and Darjeeling District of West Bengal. Therefore, these species are presented here as new distribution records for the state of Arunachal Pradesh. The present communication provides detailed descriptions with type, ecology, and images of the collected plant species. The specimens are deposited in the herbarium of the G.B. Pant National Institute of Himalayan Environment and Sustainable Development in Itanagar and at BSI APRC Itanagar (ARUN) for future references.

Codonopsis foetens

J.D.Hooker & Thomson, J. Proc. Linn. Soc., Bot. 2: 16. 1858; C.B. Clarke in Hook.f., Fl. Brit. India 3: 433.1882 (Image 1).

Type: India, Sikkim, J.D.Hooker s.n. (K!) Ascending herbs, roots slender, 10–55 cm × 1–2 cm. Caudexes abundantly branched, and thus stems several to many from one caudex, caespitose. Main stem erect or ascending, 20–40 cm tall, villous; branches numerous, aggregated in the lower part, 1–10 cm tall, usually sterile. Leaves on main stems alternate, those on branches opposite or subopposite; broadly ovate to elliptic-ovate, caudate to cordate at base, 3–11 mm × 3–10 mm, densely white pilose on both surfaces; margin entire or subentire, apex obtuse; petiole 1–3 mm, pilose. Flowers solitary (rarely several), terminal on main stems and sometimes branches, ± pendent; pedicels 4.5–3.5 cm, terminal, glabrous or sparsely pilose. Hypanthia 3–4 mm × 7.5–9.0 mm, broadly subglobose, glabrous or sparsely pilose. Calyx tube adnate to ovary up to middle, semiglobose or hemispherical, glabrous or very sparsely white hispidulous, perigynous; lobes ovate, ovate-oblong, or ovate-lanceolate, 7–20 mm × 2–7 mm, rather densely hispidulous, entire, recurved at margin, apex acute or obtuse. Corolla epigynous, pale blue or pale purple with interior markings, globose-campanulate, 2.0–4.5 cm × 2.5–3 cm; lobes suborbicular, 8–12 mm, apex obtuse or acute, tube 15–20 mm long. Stamens glabrous; filaments slightly dilated at base, ca. 5mm; anthers 4–5 mm; anther 3–5 mm long. Ovary semi inferior; style ca. 9mm long. Capsule obconical at inferior part, conical at superior part, ca. 2.0cm × 1.5cm. Seeds brownish-yellow, ellipsoid or oblong, ca. 1mm, smooth.

Flowering and fruiting: July–October.

Habitat: Found in the alpine habitats of the Himalaya at an elevation of 3500–4500 m along grassy slopes, alpine scrub, crevices, forests, and meadows at forest margins on north-facing slopes.

Image 1. *Codonopsis foetens* Hook.f. & Thoms.: A - Habit | B - Leaves | C - Closeup of open flower. © K.S. Kanwal.

Distribution: India (Sikkim and Arunachal Pradesh), Bhutan, Nepal, and China (Xizang, Zizhique, and northwestern Yunnan).

Specimen examined: (ARUN!) 1020, 11.viii.2017, India, Arunachal Pradesh, Tawang District, 27.696^{0}N & 91.842^{0}E, above 4,000m, coll. Lod, Roona & K.S. Kanwal (Image 3).

Ecology and threats*:* This terrestrial plant grows on grassy slopes in alpine pastures near Kyo Tso Wetlands. The species is facing threats from grazing by domestic animals (mainly yak and sheep), firewood collection, unregulated tourism, solid waste generation, and development projects. Climate change may be a future threat for the species. Therefore, in situ and ex situ conservation measures are essentially required for the conservation of this species.

Codonopsis thalictrifolia

Wall. in Roxb., Fl. Ind. 2: 106. 1824; Hook.f. & Thoms. In J. Linn. Soc. 2:16 1858; C.B. Clarke in Hook.f., Fl. Brit. India 3: 432.1882. (Image 2)

Type: Nepal, Gosainthan, *Wallich cat. no. 1297* (K!)

Ascending herbs, 10–35 cm high; roots carrot-shaped, 15–20 cm × 0.5–1.0 cm. Stems robust, sparsely pilose or glabrous, profusely branched near base; branches sterile, slender, leafy, aggregated at base of

Image 2. *Codonopsis thalictrifolia* Wall. in Roxb.: A - Habitat | B - Habit | C - Closeup of open flower. © K.S. Kanwal.

main stems, 4–6 cm, villous. Leaves on main stems alternate, those on branches subopposite; petiole ca. 2mm, white hirsute; blade ovate or suborbicular, 2.0–5.5 mm × 2–6 mm, both surfaces villous, base cordate or truncate, margin sub-entire or crenate, apex obtuse or acute. Flowers solitary, terminal on main stems, slightly pendent. Hypanthis 1.5–2.0 mm × 6–8 mm, broadly obconic, scabrid-pilose. Calyx tube perigynous; adnate to ovary up to middle, hemispheric, 3–5 mm × 6–10 mm, glabrous or villous; lobes triangular or oblong, 5mm × 3mm, outside hairy, margin entire, apex acute or obtuse; sinus between lobes broad and obtuse. Corolla tubular-campanulate, 2.0–4.8 cm × 1.5–4.3 cm, shallowly lobed; lobes triangular, 2–4 mm × 7–9 mm, apex obtuse; tube pale blue, 18–23 mm long, glabrous or occasionally sparsely villous. Filaments slightly dilated at base, ca. 1cm; anthers ca. 3mm, villous at connective. Capsule hemispherical at base, conical toward apex, rostrate. Seeds numerous, brownish-yellow, ellipsoid, smooth.

Flowering and fruiting: July–October

Habitat: Found in the alpine habitats of the Himalaya at an elevation of 3300–4500 m along grassy slopes, alpine scrub, crevices, forests, and meadows at forest margins on north-facing slopes.

Distribution: India (Singalelah in West Bengal, Dzongri to Aloktong in Sikkim, and Arunachal Pradesh), Bhutan, Nepal, and China (Xizang and Zizhique).

Specimen examined: (ARUN!) 1019, 11.viii.2017, India, Arunachal Pradesh, Tawang District, three samples, 27.654^{0}N & 91.863^{0}E, 4,000m, coll. Lod, Roona & K.S. Kanwal (Image 4).

Ecology and threats: The species grows on the hilltop of an alpine pasture of Nagula Lake. Grazing, fuelwood collection, tourism activities, infrastructure establishment, and change of land use pattern were observed as some of the threats for the species in the area. The catchment area of the lake is used as a grazing site by the local villagers for their cattle, mainly yak

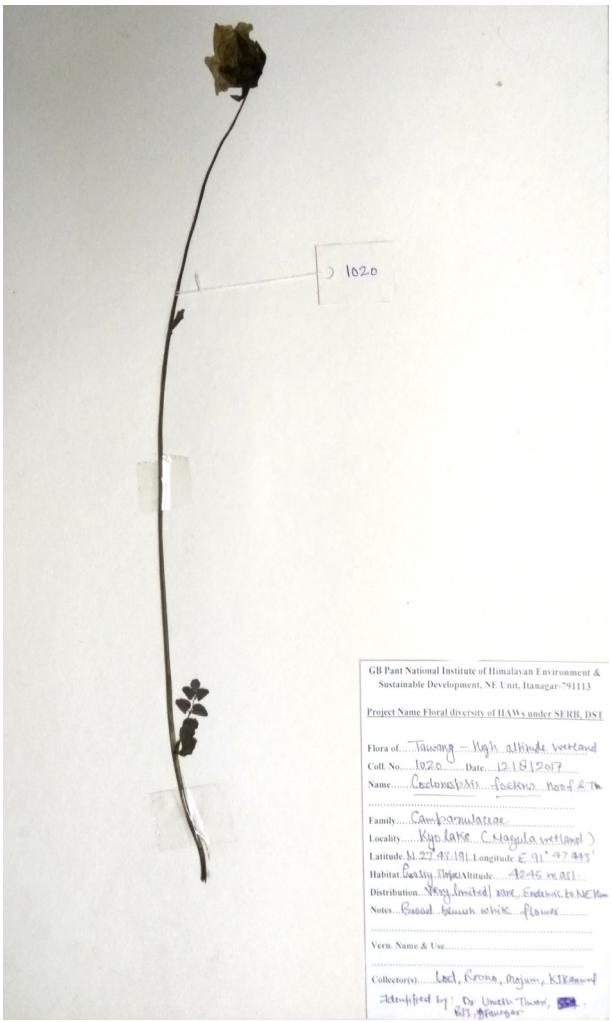

Image 3. Herbarium image of *Codonopsis foetens* [(ARUN!) 1020].

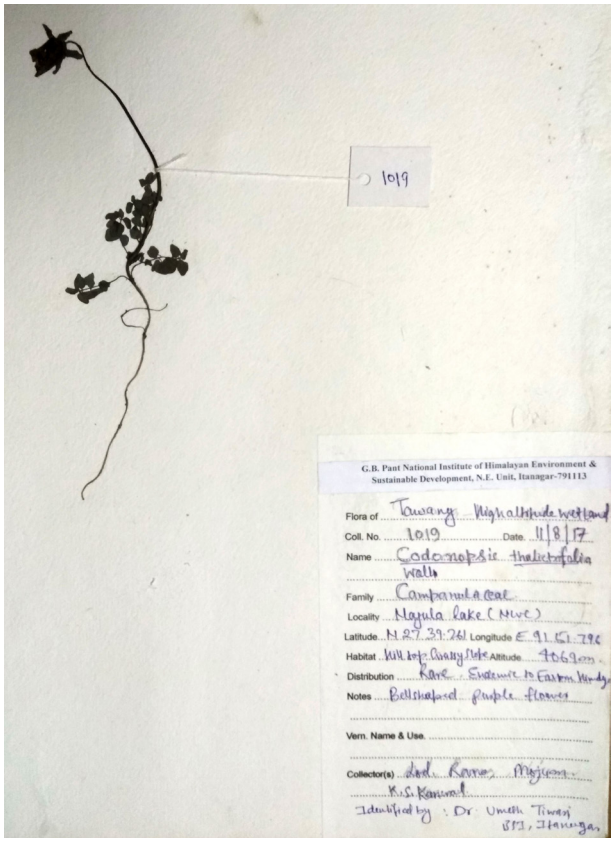

Image 4. Herbarium image of *Codonopsis thalictrifolia* [(ARUN!) 1019].

and sheep. The species may face a further threat from climate change in the near future. Hence, conservation and management measures are required for the conservation of this species.

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