

Corydalis cashmeriana var. longicalcarata (Papaveraceae), an addition to the flora of Western Himalaya, India

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Abstract

We report *Corydalis cashmeriana* var. *longicalcarata* (Papaveraceae) for the first time from Kashmir, a region located in Western Himalaya, India. It differs from *C. cashmeriana* var. *cashmeriana* in having raceme with only two flowers, long upper petal and spur with deflexed tip. Detailed morphological notes along with photographs are provided to validate this new distribution record and facilitate the field identification of this taxon.

Introduction

The genus *Corydalis* DC., belonging to the family Papaveraceae, comprises about 538 species globally, and mainly distributed in the northern temperate zone (POWO, 2024). This genus exhibits high levels of morphological diversity (Ren et al., 2021; Kim et al., 2023). The leaves, fruits, seeds, and particularly the floral structure is complex and show high variability, which poses significant challenges in accurate taxonomic identification (Ren et al., 2021; Kim et al., 2023). The main characters used in species delimitation in the genus includes nature of leaves, claw of lower petal, shape of spur and fruit (Kim et al., 2023). *Corydalis* occur in a wide range of habitats, such as riversides, forests, grasslands, screes and rocky crevices (Liu et al., 2024). The genus is considered to be a rich source of isoquinoline alkaloids with various biological properties including acetylcholinesterase inhibitory effects, anti-proliferative activities, antiviral activities and anti-plasmodial activities (Iranshahy et al., 2014).

Till date, 59 species of the genus have been recorded from India, and mainly restricted to the Himalayan region (BSI eflora of India, 2024; POWO, 2024). During a recent botanical survey, we collected interesting plant specimens from Margan valley in Kashmir Himalaya. After critical examination of the plant specimens and perusal of taxonomic literature (Hooker, 1875; Stewart, 1972; Sharma & Balakrishnan, 1993; Jiang et al., 2018; Ren et al., 2019; Chen et al., 2023), online floras and databases (eFlora of China, 2008; Zhang et al., 2016; eFlora of Pakistan, 2024; BSI eflora of India, 2024), protologue (Srivastava, 1998) and type (K000653648), the specimens were identified as *Corydalis cashmeriana* var. *longicalcarata* (D.G.Long) R.C.Srivast. The taxon was previously reported to be restricted to Eastern Himalaya, Nepal and Tibet (Long, 1984; Prain, 1896; Srivastava, 1998; POWO, 2024). Therefore, being a new distributional record to the Western Himalaya from Kashmir, the present study provides detailed taxonomic account, including description, contrasting characters with closely related taxa, and photographic illustrations of diagnostic characters..

Materials and methods

The field tour was conducted in the Kashmir Himalaya in July 2024, covering an area of ~ 15,000 km² with 64% of the area being mountainous (Ganie et al., 2019; Dar and Khuroo, 2020). The elevation ranges from ca. 1600 to 5400 m asl (Khuroo et al., 2007). The region experiences well demarcated four seasons: the spring which lasts from March–May; the summer from June–August; the autumn from September–November; and winter from December–February (Dar and Dar, 2021; Islam et al., 2023a,b,c).

The natural vegetation at higher elevations in the region mostly consists of alpine meadows and coniferous forests (Khuroo et al., 2007). During floristic surveys, standard taxonomic methods have been followed for collection, drying and further processing of the herbarium specimens (Bridson and Forman, 1998). The specimens have been deposited in University of Kashmir herbarium (KASH) with proper voucher specimen number. The macro photographs were taken in field by mobile phone camera (Make: iPhone 15 Pro Max). The microphotography of the diagnostic characters was carried out under a stereozoom microscope (Make: Leica S9D, Germany) integrated with image processing software (LASX). The location map was prepared using ArcGIS (version 10.2) software.

Results

Taxonomic treatment

***Corydalis cashmeriana* var. *longicalcarata* (D.G.Long) R.C.Srivast. Fl. Sikkim: 72 (1998).**

Synonyms: *Corydalis cashmeriana* subsp. *longicalcarata* (D.G.Long) Lidén in Fl. China 7: 392 (2008), *C. ecristata* subsp. *longicalcarata* (D.G.Long) C.Y.Wu in Fl. Reipubl. Popularis Sin. 32: 272 (1999), *C. ecristata* var. *longicalcarata* D.G.Long in Notes Roy. Bot. Gard. Edinburgh 42: 93 (1984).

Type??

Specimen examined: INDIA. Jammu and Kashmir, Kashmir, Anantnag, Margan valley, 33° 44' 58" N, 75° 29' 51" E, 3750 m a.s.l., 07-07-2024, *Tajamul Islam, Anzar Ahmad Khuroo & Sameer A. Sofi* (KASH 38640).

Description

Herb, perennial, up to 10 cm tall, stem glabrous; rootstock tuberous. Stems erect and bears 2 cauline leaves, alternate, present above middle of the stem. Radical leaves petiolate, 2–3 cm long, obcuneate, palmately, 3-lobes, glaucous, petioles filiform, sheathing at base; lobes obovate, deeply ternate; ultimate leaflets linear, linear oblanceolate or obovate. Cauline leaves subsessile, glaucous, elliptic to oblong-lanceolate, deeply lobed with 4–7-pinnatisect; lobules linear or oblanceolate, acute, apices minutely mucronate, upper leaf 6.5–7.0 × 2.2–2.5 mm. Inflorescence raceme, 2-flowered, bracts foliaceous, laciniate. Pedicel 8.0–8.5 × 0.3–0.5 mm. Flowers bisexual, 14–16 mm long with spur 5–6 mm long, slightly deflexed at tip. Petals 4, white; upper petal small, 9.0–10.5 mm long, concave, broad, clawed at base, apices acute; lower petal rhombic-ovate, 12.5–13.0 mm long; inner petals 8.5–9.0 mm long. Stamens 2, 0.8–1.0 mm long; anther lobe yellow, 0.4–0.6 × 0.2–0.4 mm. Ovary glabrous, with curved dilated flattened bilobed stigma. Fruit capsule (Fig. 2).

Notes: Royle (1834) has, first of all, described *Corydalis cashmeriana* from India based on the plant material collected from Kashmir, NW Himalaya. After that, Prain (1896) recognised an infraspecific taxa (variety) as *Corydalis cashmeriana* var. *ecristata* based on the specimen collected by Ludlow and co-workers from Bhutan (K000653648). This variety was later on elevated to species rank as *Corydalis*

ecristata (Prain) Long (Long, 1984). Meanwhile, Long (1984) has also described its new variety as *Corydalis ecristata* var. *longicalcarata*. However, it was more related to the *C. cashmeriana*, Srivastava (1998) therefore proposed a new combination as *Corydalis cashmeriana* var. *longicalcarata*. The *C. cashmeriana* var. *longicalcarata* morphologically resembles with *C. cashmeriana* var. *cashmeriana* in some characters such as habit, leaf type and fruit type; however, it differs from the latter in having white two-flowered raceme, long upper petal including long spur, deflexed at tip (Fig. 2).

Phenology: **flowering:** June–July; **fruiting:** July–August.

Distribution: India: Eastern Himalaya (Sikkim, Arunachal Pradesh), Nepal and Tibet, and Western Himalaya (Kashmir).

Ecology: It occurs in the alpine zone at an elevation of 3750 m a.s.l. The habitat is a typical alpine moist scrub dominated by *Rhododendron hypenanthum* Balf.f. and herbaceous plants such as *Bergenia ciliata* (Haw.) Sternb., *Sibbaldia cuneata* Edgew., *Geum elatum* Wall. ex G.Don, *Myosotis alpestris* F.W.Schmidt, *Bistorta affinis* (D.Don) Greene, *Lindelofia longiflora* (DC.) Baill., *Anemonastrum obtusilobum* (D.Don) Mosyakin, *Lagotis cashmeriana* (Royle ex Benth.) Rupr., *Primula reptans* Hook.f. ex G.Watt.

Discussion

In biodiversity science, besides discovery of new species, new distribution records form the foundation of biodiversity datasets. In particular, urgent efforts are required to report the species distribution records from global biodiversity hotspots, such as the Himalaya, in order to overcome the Wallacean shortfall in biodiversity (Gulzar et al., 2021; Wani et al 2024). The new record of *C. cashmeriana* var. *longicalcarata* from Kashmir is the first distribution record for the flora of Western Himalaya, India.

The alpine areas in the Himalaya represent the precious reservoirs of biodiversity, but their vegetation is among the least investigated (Fait et al., 2020; Rasray et al. 2024). Till now, 31 taxa of this genus have been reported from Kashmir Himalaya (Dar et al., 2011). *Corydalis cashmeriana* var. *longicalcarata* was collected from the natural population in the Margan valley in Kashmir Himalaya. We have located a single population of this taxon from the locality. Currently, livestock overgrazing and the recent huge influx of tourists poses a significant threat to the population survival of this taxon. It is suggested that the seeds of this taxon may be collected and cultivated for its *ex-situ* conservation strategy.

Declarations

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Ethics: not applicable

Consent to Publish: not applicable

Consent to Participate: not applicable

Competing Interest: the authors declared that they have no competing interest.

Plant Guidelines

The collection of plant material, complied with relevant institutional, national, and international guidelines and legislation.

Data Availability Statement

Data sharing is not applicable to this article as no datasets were generated or analysed during the current study.

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Figures

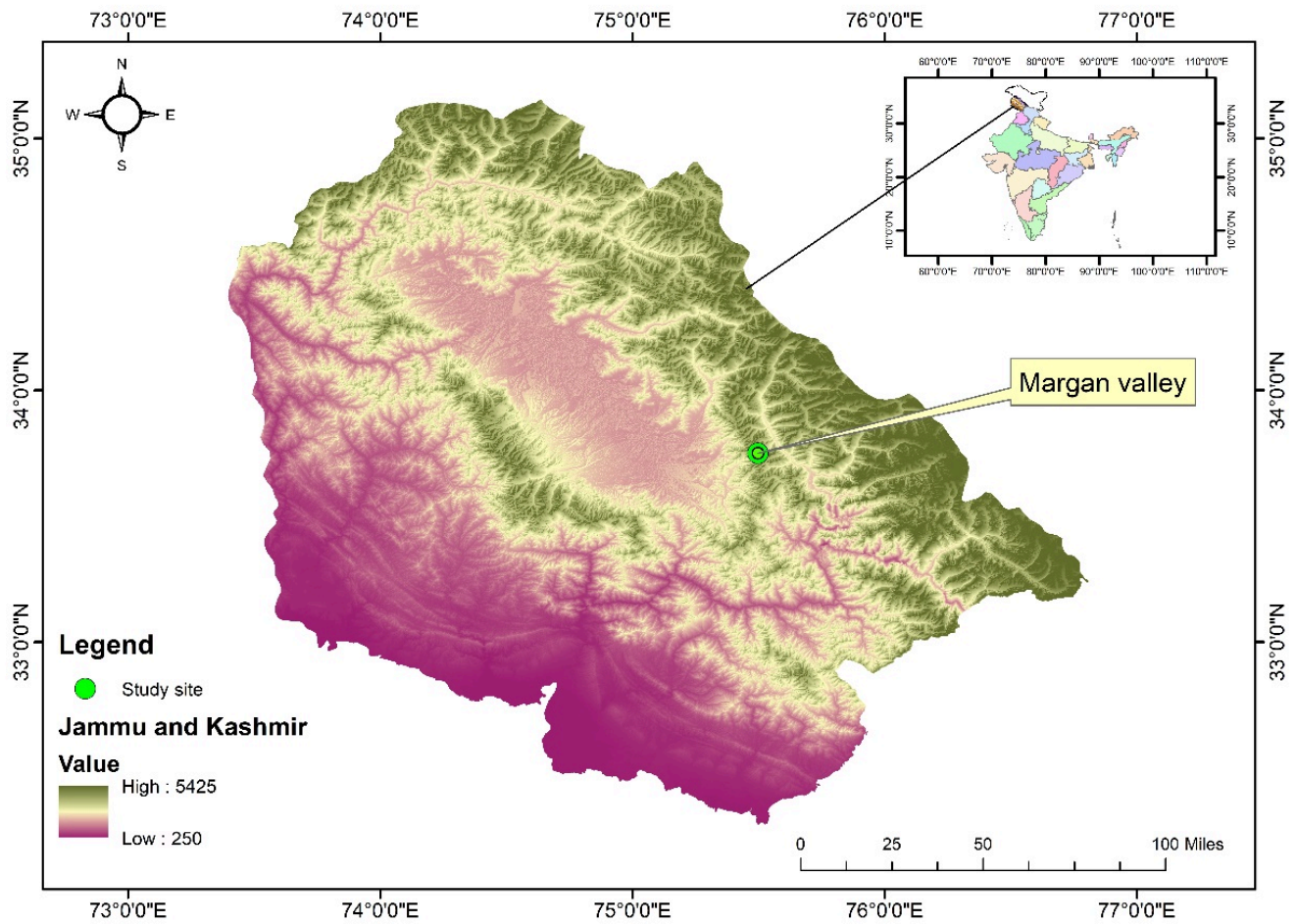


Figure 1

Location map of *Corydalis cashmeriana* var. *longicalcarata* (D.G.Long) R.C.Srivast. in Kashmir Himalaya.

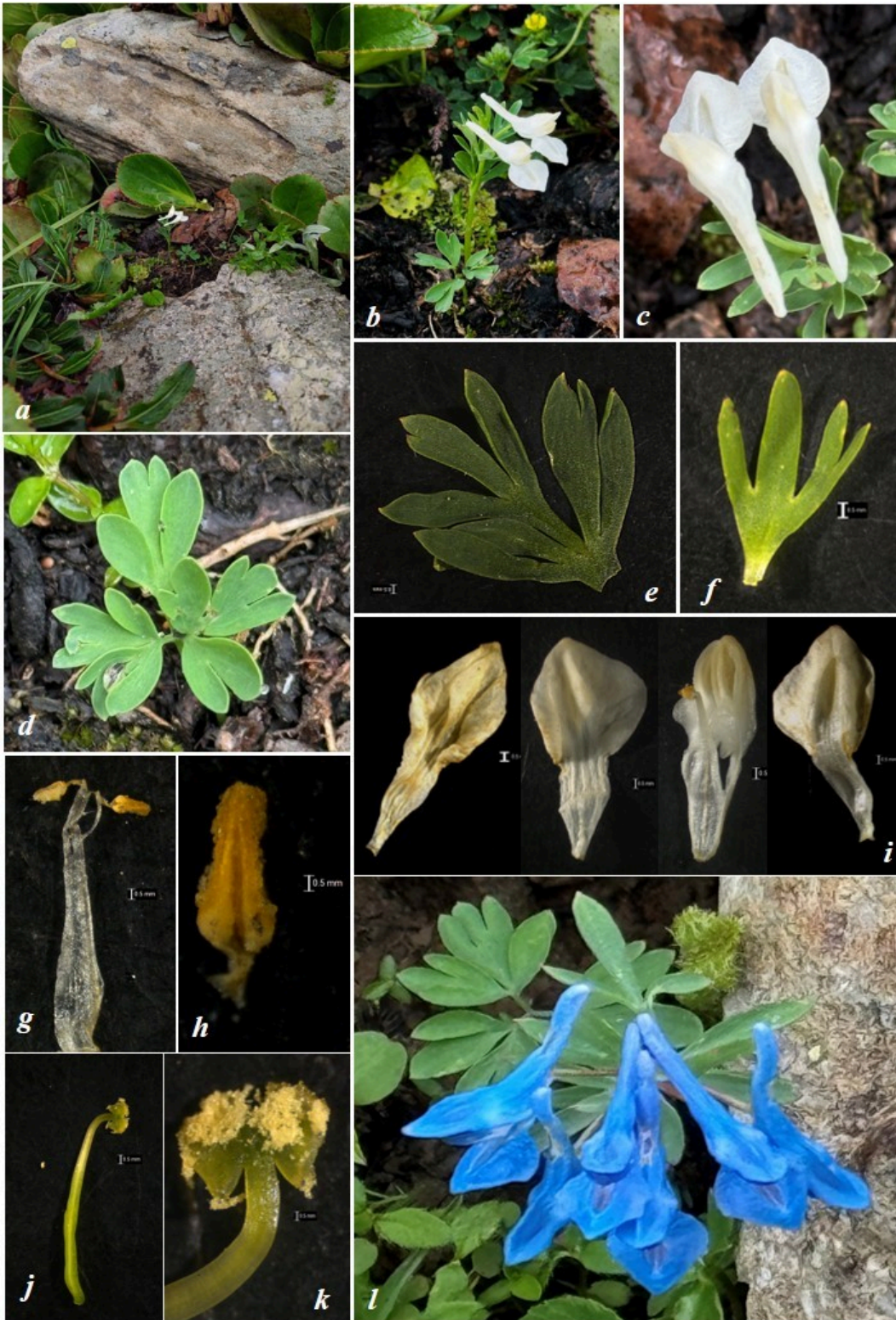


Figure 2

Corydalis cashmeriana var. *longicalcarata*. **a.** Habitat; **b.** Habit; **c.** Top view of flowers (inflorescence); **d.** Radicle leaves; **e&f.** Cauline leaves; **g.** Stamens attached to lower petal; **h.** Anther; **i.** Petals; **j&k.** Stigma; **l.** *Corydalis cashmeriana* var. *cashmeriana*.