

**ODONTOSTEMMA BALFOURIANA COMB. NOV., A
NEGLECTED SPECIES FROM THE INDIAN
HIMALAYA, AND RESURRECTION OF *STELLARIA
DEPAUPERATA* EDGEW.**

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Odontostemma balfouriana (W.W.Sm.) Satish Chandra & D.S.Rawat is recorded here as a new record for the flora of India. Surprisingly, the species (previously known as *Arenaria balfouriana* W.W.Sm.) was erroneously considered to be a synonym of *Stellaria depauperata* Edgew. After examining protologues, fresh specimens and herbarium specimens housed in BSD, CAL and DD, the authors have resolved this taxonomic confusion and provided a new combination and lectotype for *Arenaria balfouriana*. Additionally, *Stellaria depauperata*, illegitimately combined under *Arenaria*, is resurrected and recognised as a distinct species.

Keywords. *Arenaria*, Caryophyllaceae, new record, *Odontostemma*, Uttarakhand.

INTRODUCTION

The genus *Odontostemma* Benth. ex G.Don belongs to tribe Alsineae DC. of the family Caryophyllaceae Juss. *Arenaria* L. *sensu* McNeill (1962) was split into six genera to achieve monophyly, namely *Arenaria* L. *s.s.*, *Dolophragma* Fenzl, *Eremogone* Fenzl, *Himgiria* Pusalkar & D.K.Singh, *Odontostemma* Benth. ex G.Don and *Shivparvatia* Pusalkar & D.K.Singh (Harbaugh *et al.*, 2010; Greenberg & Donoghue, 2011; Pusalkar & Singh, 2015; Sadeghian *et al.*, 2015). *Odontostemma* is endemic to the Sino-Himalayan area and is represented by about 65 species (Sadeghian *et al.*, 2015). In India there are four species, namely *Odontostemma glandulosum* Benth. ex G.Don, *O. littledalei* (Hemsl.) Rabeler & W.L.Wagner, *O. thangoense* (W.W.Sm.) Rabeler & W.L.Wagner (Rabeler & Wagner, 2016) and *O. balfouriana* (W.W.Sm.) Satish Chandra & D.S.Rawat (proposed here). The genus is distributed in higher alpine areas, but because it is poorly represented in Indian herbaria, some of the species are not completely known. Consequently, it is likely that new species of *Odontostemma* will be found in the Himalayan region.

The two species *Odontostemma balfouriana* (*Arenaria balfouriana* W.W.Sm.) and *Stellaria depauperata* Edgew. grow together in the wild and share many morphological similarities, including having quadrangular violet stems, violet anthers, three styles and an overall similarity in habit. *Stellaria depauperata* was first collected by J. D. Hooker from

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Sikkim Himalaya in 1849, and Edgeworth (1874) described it as a new species in *The Flora of British India*. In the Western Himalaya, both species were first collected by J. F. Duthie from Kumaon and Garhwal Himalaya of Uttarakhand State, India, during his 1884 and 1885 expeditions, respectively. During his exploration of Garhwal Himalaya, Duthie collected an apetalous specimen (3866a [DD]) from the Pangarchula area near the Kuari Pass and a specimen with petals (3866 [DD]) from the Kuari Pass itself, erroneously identifying both as *Stellaria depauperata*. While exploring the Kumaon Himalaya, Duthie again collected similar petalous (2763 [DD]) and apetalous (2764 [DD]) specimens from Ralam Valley and named them as a new species, *Arenaria tenella* Duthie, but without validly publishing the name. Williams (1898) later did so (*Arenaria tenella* Duthie ex F.N.Williams) on the basis of Duthie 2763 from Kumaon Himalaya, India (lectotype designated by Chandra *et al.*, 2017: BM000946345, image!). However, this name, being a later homonym of *Arenaria tenella* Kitaibel (1814), is illegitimate under Article 53.1 of the *International Code of Nomenclature for algae, fungi and plants* (ICN) (Turland *et al.*, 2018).

Smith (1913) collected a few specimens of *Arenaria* from Changu and a nearby area of Sikkim Himalaya, India. Smith 4240 (CAL) was identified as *Stellaria depauperata*, and Smith 4222 (syntypes, E00317567 and E00317566, images! [CAL]) and 4246 (syntype, E00317568, image! [CAL]) were the basis for the description of the new species *Arenaria balfouriana*. During the present study, it was found that all the specimens collected by Smith are petaliferous and belong to *Arenaria balfouriana*.

Arenaria bhutanica Majumdar & Babu was published on the basis of a specimen collected by G. Sen Gupta (721, holotype CAL!) from the Chila area of Bhutan. Majumdar & Babu (1969) did not refer to the protologue or specimens of *Arenaria balfouriana* (Smith, 1913) and published a new species. During this study, it was also found that this collection also belongs to *Arenaria balfouriana*. Therefore, *Arenaria bhutanica* becomes a synonym of *Arenaria balfouriana*.

MATERIAL AND METHODS

Specimens of *Odontostemma balfouriana* (erstwhile *Arenaria balfouriana*) and *Stellaria depauperata* were collected from the Shilasamudra, Kuari Pass and Ralam areas of Uttarakhand State, India. The morphological characteristics of both species were critically compared with their protologues (Edgeworth, 1874; Smith, 1913); other relevant literature (Williams, 1898; McNeill, 1962; Majumdar & Babu, 1969; Hara, 1976; Grierson, 1984; Majumdar, 1993; Srivastava, 1998); specimens housed in BSD, CAL and DD herbaria; and images of the species from E, GH and K herbaria. Turland *et al.* (2018) was followed for nomenclature.

RESULTS AND DISCUSSION

Despite the apparent morphological similarities between *Odontostemma balfouriana* and *Stellaria depauperata*, they differ significantly (Table and Fig). *Odontostemma balfouriana* is a petaliferous species with entire petals, a character that in combination with other features suffice to place it in the genus *Odontostemma*. *Stellaria depauperata*,

TABLE. Comparison of *Odontostemma balfouriana* (W.W.Sm.) Satish Chandra & D.S.Rawat and *Stellaria depauperata* Edgw.

Character	<i>Odontostemma balfouriana</i>	<i>Stellaria depauperata</i>
Plant height (cm)	5–30	5–10
Leaves	3 to many pairs per branch, linear-lanceolate, 5–12 mm long, saccate, a little flashy, curved, vein obscure	2–6 pairs per branch, linear-lanceolate, 3–6 mm long, papery, curved, vein prominent
Inflorescence	Flowers are solitary terminal, solitary axillary, in pairs or in a cyme (depending on age of plant)	Flowers are solitary terminal or axillary
Sepals	Lanceolate, broadly scarious, 3 veins, midvein obscure, obtuse-subacute at apex, curved when fruit mature	Lanceolate, broadly scarious, veins 3, midvein prominent, other two obscure, acute at apex, straight, never curved
Petals	5, consistently present	Consistently absent
Stamens	10; 5 antisealous stamens with prominent gland at filament base	5 or 6; antisealous, gland at filament base absent
Mature ovary and fruit	Completely exposed owing to recurved sepals	Completely covered with erect sepals

being apetalous, is a perplexing species for its resemblance to some species of *Arenaria s.l.* subgen. *Odontostemma* sect. *Reductae* C.Y.Wu (Zhengyi *et al.*, 2001). Because this species was originally described in the genus *Stellaria*, we prefer to treat it as such until its correct position within *Stellaria* or *Arenaria* is clarified by molecular studies.

TAXONOMIC TREATMENT

A new combination for Arenaria balfouriana

To take account of the recent taxonomic and nomenclatural changes in the genus *Arenaria s.l.*, a new combination for the petaliferous plant is proposed here. The key morphological characteristics of the species are: stem thin, delicate, tetragonal, with one line of hairs; leaves oblong-lanceolate, recurved, glabrous, margin smooth, apex acute-acuminate; sepal saccate, not hardened at the base, lanceolate, glabrous, midvein inconspicuous, margin broadly scarious, apex obtuse, curved; and petals longer than sepals, resembling those of the genus *Odontostemma*. The earliest proposed name for the species was *Arenaria tenella*, but this is illegitimate under Article 53.1 of Turland *et al.* (2018) because it is a later homonym. The next available name for the species is *Arenaria balfouriana*, and this is the basis of the new combination.

Odontostemma balfouriana* (W.W.Sm.) Satish Chandra & D.S.Rawat, **comb. nov.* – Type: India, Sikkim, Changu, near west of Tanka La, altitude 12,000–14,000 ft, 12 viii 1910, *W.W.Smith* 4246 (lecto CAL!, designated here; isolecto E [E00317568], image! at https://data.rbge.org.uk/search/herbarium/?specimen_num=321059&cfg=zoom.cfg&filename=E00317568.zip).



FIG. A–C, *Odontostemma balfouriana* (W.W.Sm.) Satish Chandra & D.S.Rawat, comb. nov.: A, plant with *Saxifraga* sp.; B, flower; C, lateral view of flower. D–F, *Stellaria depauperata*: D, plant; E, flower; F, lateral view of flower.

Arenaria balfouriana W.W.Sm., Rec. Bot. Surv. India 4: 356 (1913), *non sensu* Grierson in Grierson & Long., Fl. Bhutan 1: 273 (1984).

Arenaria bhutanica Majumdar & Babu, J. Arn. Arb. 50: 626, f. 1 (1969).

Herb, annual or biennial. *Stem* yellowish or violet, suberect, 5–30 cm, delicate, tetragonal, with one line of eglandular hairs. *Leaves* sessile, oblong-lanceolate, 5–12 × 1–2 mm, glabrous, margin smooth, apex acute-acuminate, recurved. *Flower* solitary and terminal, solitary and axillary, in pairs or in a cyme (depending on the age of the plant). *Pedicels* slender, 1–2.5 cm long, erect in flower, curved after fruit set, pubescent with eglandular hairs. *Sepals* 5, lanceolate, 3–4 × 1 mm, glabrous, midvein obscure, margin broadly scarious, apex obtuse-subacute, curved during fruit set. *Petals* 5, white, oblong-lanceolate, 3–5 × 1 mm, as long as or slightly exceeding sepals, apex obtuse, veins obscurely 3.

Stamens 10, in two whorls, anthers violet (yellow-brown), 2 mm, almost equal in length, a prominent gland present at the base of antisepalous stamens. *Ovary* ovoid, 1.5–2 × 1.5 mm, styles 3, 1 mm long. *Capsule* oblong, 2.5–3 × 1.5–2 mm, shorter than persistent sepals, opening by 6 valves, valves split to half of their length. *Mature ovary* completely exposed because of recurved sepals and petals. *Seeds* 10–13 per capsule, brown, compressed, c.1 mm in diameter, subreniform, smooth.

Flowering. July to August.

Fruiting. August to September.

Distribution. *Odontostemma balfouriana* is reported from both Sikkim in the Eastern Himalaya (4222, 4240 and 4246 [CAL]) and Uttarakhand in the Western Himalaya (3866 and 2763 [DD] and present collection). This suggests that it may be found throughout the Himalaya from the western to the eastern side, although it has yet to be reported from the Central Himalaya.

Additional specimens examined. INDIA. **Uttarakhand:** Pithoragarh district, Ralam valley, 3000–3600 m, 22 viii 1884, *J.F. Duthie* 2763 (DD!); 5 ix 2017, *D.S. Rawat & Satish Chandra s.n.* 875 (Govind Ballabh Pant University Herbarium Pantnagar, Uttarakhand, India!); Chamoli district, Kuari Pass, 11,000–12,000 ft, 9 ix 1885, *J.F. Duthie* 3866 (DD!); 15 viii 2006, *D.S. Rawat s.n.* 822 (Govind Ballabh Pant University Herbarium Pantnagar, Uttarakhand, India!); 22 viii 2015, *Satish Chandra s.n.* 823 (Govind Ballabh Pant University Herbarium Pantnagar, Uttarakhand, India!); Roopkund area, Silasamudra glacier, near bridge on the way to Latakopdi, 3600 m, 3 ix 2014, *D.S. Rawat & Satish Chandra s.n.* 824 (Govind Ballabh Pant University Herbarium Pantnagar, Uttarakhand, India!).

Resurrection of Stellaria depauperata

Stellaria depauperata is an apetalous species as originally described by Edgeworth (1874). Later, some specimens of the petalous species *Arenaria bhutanica* from the Eastern Himalaya were erroneously identified as *Stellaria depauperata* by Hara (1976) and a new combination, *Arenaria depauperata* (Edgew.) H.Hara, was proposed. Hara clearly mentioned the variability of the petals in different specimens of the species as he conceived it. This circumscription was followed by Majumdar (1993). However, the name *Arenaria depauperata* is illegitimate under Article 53.1 of the ICN (Turland *et al.*, 2018), being a later homonym of *Arenaria depauperata* Gay (1845). After Hara, the name *Arenaria depauperata* was used for both *Stellaria depauperata* and *Arenaria bhutanica*. Recently, following the circumscription of Hara (1976), Rabeler & Wagner (2015) and Chandra *et al.* (2017) each proposed new combinations for this species: *Eremogone depauperata* (Edgew.) Rabeler & W.L.Wagner and *Odontostemma depauperata* (Edgew.) Satish Chandra, D.S.Rawat & Pusalkar, respectively. All combinations of ‘*depauperata*’ are based on the type specimen of *Stellaria depauperata* collected by J. D. Hooker from Sikkim Himalaya (*Hooker s.n.*, GH00353889) and are here treated as synonyms of that name. During this study, it was found that the type collection of *Arenaria bhutanica* belongs to *Arenaria balfouriana*, and the name *Stellaria depauperata* is restored.

Stellaria depauperata Edgew., Fl. Brit. India 1: 234 (1874), *non sensu* Majumdar in B.D. Sharma & N.P. Balakr., Fl. India 2: 509 (1993). – Type: India, Sikkim, Yeumtong, altitude 15,000 ft, vii 1849, *J. D. Hooker s.n.* (lecto GH image! [GH00353889], designated by Chandra *et al.*, 2017).

Herb, perennial, lax caespitose, 5–8 cm long. *Root tap root*, perennial, with many accessory roots. *Stem* slender, delicate, 3–8 cm long, sparingly branched, branches decumbent, rectangular, pubescent with 1 or 2 lines of eglandular multicellular uniseriate trichomes. *Leaves* linear to lanceolate, entire, 3–6 × 1–1.5 mm, basal leaves shorter, upper longer, curved in dry specimens, apex narrowly acute, both surfaces glabrous, eglandular hairy on margins at base, midvein conspicuous. *Bracts* foliaceous, linear to lanceolate, 2–4 × 0.5–1.5 mm. *Flowers* solitary axillary or in pair, small, inconspicuous. *Pedicel* capillary, 5–15 mm long (elongating to 30 mm in fruit), sometimes recurved, pubescent all around. *Flower* bisexual, 0.2–0.3 mm across, greenish. *Sepals* 5, green, lanceolate, 2.5–3.5 × 1–1.5 mm, acute, margins broadly scarious, veins 3, central one conspicuous other two fused at middle with central nerve, glabrous or with few trichomes at base. *Petals* absent. *Stamens* 5 or 6 (or 7), filament 1.5–2 mm long, antisepalous if 5; anthers yellowish. *Ovary* ovoid, 1.5–2 mm long, glabrous; styles 3, divergent at anthesis, 1 mm long; stigma papillate on adaxial surface. *Fruit* ovate, 3–4 mm long, equal to slightly shorter than sepal length, opening by 6 valves to halfway down, glabrous, enclosed by persistent sepals. *Seeds* brown, 6–8 per fruit, reniform to subreniform, sculpturing rugulose, testa cell shape elongated polygonal c.1 mm in diameter, wrinkled, compressed.

Flowering. July to August.

Fruiting. August to September.

Distribution. *Stellaria depauperata* is reported from both Sikkim in the Eastern Himalaya (GH-00353889, K000723648) and Uttarakhand in the west (3866a, 30945 a and 30945 b [DD] and present collection). It is possible that it may be found throughout the Himalaya, although it has yet to be reported from the Central Himalaya.

Additional specimens examined. INDIA. Sikkim, Yeumtong, altitude 15,000 ft, 6 ix 1849, *J. D. Hooker s.n.* (K [K000723648], image! at <http://apps.keew.org/herbcat/getImage.do?imageBarcode=K000723648>, albeit under the incorrect name *Stellaria subumbellata* Edgew.); Uttarakhand, Pithoragarh district, Ralam valley, 3000–3600 m, 26 viii 1884, *J.F. Duthie* 2764 (DD!); 5 ix 2017, *D.S. Rawat & Satish Chandra s.n.* 876 (Govind Ballabh Pant University Herbarium Pantnagar, Uttarakhand, India!); Chamoli district, Kuari Pass, near Pangarchula, 12,000–13,000 ft, 9 ix 1885, *J.F. Duthie* 3866a (DD!); 15 viii 2006, *D.S. Rawat s.n.* 749 (Govind Ballabh Pant University Herbarium Pantnagar, Uttarakhand, India!); 22 viii 2015, *Satish Chandra s.n.* 750 (Govind Ballabh Pant University Herbarium Pantnagar, Uttarakhand, India!); Roopkund area, Kailuvinayak, 4500 m, 1 × 1963, *U.C. Bhattacharya* 30945 a and 30945 b (BSD!).

CONCLUSION

The species *Odontostemma balfouriana* has been completely ignored in the Indian floristic literature, despite its type locality being in Sikkim. It becomes a new record for the Indian flora, because the species is not mentioned in the *Flora of India* (Majumdar, 1993) or subsequent literature (Srivastava, 1998). It is also concluded that *Odontostemma balfouriana* and *Stellaria depauperata* are different species that occur together in nature, share a similar niche and are present in both the Eastern and Western Himalaya. *Stellaria depauperata* is resurrected from synonymy and recognised as a distinct species.

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