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***Bistorta tenuifolia* var. *gidarensis* (Polygonaceae), a new variety from India**

ISHWARI DATT RAI^{1*}, GAJENDRA SINGH¹ & GOPAL SINGH RAWAT^{1,2}

¹ Wildlife Institute of India, P.O. Box # 18, Chandrabani, Dehradun, Uttarakhand, 248001, India

² Ecosystem Services, International Centre for Integrated Mountain Development (ICIMOD), Kathmandu, Nepal

* Corresponding author: ishwari.raai@gmail.com

Abstract

During a botanical excursion of the alpine meadows in the state of Uttarakhand, we came across a viviparous species under the genus *Bistorta* (Polygonaceae). Subsequently, the taxon was also recorded from the Great Himalayan National Park, Himachal Pradesh. The gross morphology suggested this plant belong to *B. tenuifolia* but we found differences in the shape of perianth lobe and the size of stamens from those of the typical *B. tenuifolia*. On the basis of the acute perianth lobes, the minute stamens that are included in the perianth and the reniform anthers, we describe a new variety, *B. tenuifolia* var. *gidarensis* and compared it with the nominal variety and the related species *B. vivipara*.

Keywords: *Bistorta*, *B. vivipara*, *B. tenuifolia* var. *tenuifolia*, new taxon, Uttarakhand, Western Himalaya

Introduction

Polygonaceae Juss. is a cosmopolitan family including 48 genera and about 1200 species (Sanchez & Kron 2008, Li *et al.* 2003) all characterized by the presence of an ocrea that derived from the fusion of the stipules. The taxonomy of this family is complex (Ronse Decraene & Akeroyd 1988) with an high phenotypic variability (Brandbyge 1993). *Polygonum* Linnaeus (1753: 359) is the largest genus of Polygonaceae, with 230 species (Li *et al.* 2003). Molecular studies show the monophyly of Polygonaceae, while it is paraphyletic at sub-family level (Galasso *et al.* 2009). Kim & Donoghue (2008) included *Aconogonon* (Meisner 1826: 55) Reichenbach (1837: 236), *Bistorta* Miller (1754: 194) and *Koenigia* Linnaeus (1767: 104) in one clade that is a sister group of *Persicaria* Miller (1754: 1054). The genus *Bistorta* is characterized by the presence of a solitary terminal spicate inflorescence, basal leaves and oblique ocrea (Galasso *et al.* 2009) and it comprises 50 species (Li *et al.* 2003) of which about 8 are recorded in the Western Himalaya (Uniyal *et al.* 2007). Viviparous bistorts are represented by 3 species in the world, *P. suffultoides* An Jen Li (1995: 415), *B. vivipara* (Linnaeus 1753: 360) Gray (1821: 268) and *B. tenuifolia* (Hsien Wu Kung 1935: 367) Futoshi Miyamoto & Hideaki Ohba (2005: 280). The viviparous species are characterized by the presence of bulbils in the inflorescence (sometimes only in the basal part). All the three species occur in China. *B. vivipara* and *B. tenuifolia* are also recorded in Nepal. The only species recorded in India is *B. vivipara*.

In the present study a new variety of *B. tenuifolia* from the Western Himalaya is described. During the survey of alpine meadows in Western Himalaya, we found a viviparous species of *Bistorta* which was different from the *B. vivipara* and had affinities with *B. tenuifolia*.

Material and methods

Twenty five specimens were collected from three localities, of which Gidara and Kanasar are located in Uttarakhand and Great Himalayan National Park in Himachal Pradesh. The exsiccata were deposited in the

Wildlife Institute of India, Dehradun (WII). Specimens at B, BM, BSD, CAL, DD, K, KATH, PE and TI (acronyms according to Thiers 2011) are also examined. A morphological analysis based on 29 characters (Table 1) was performed. Literature data (e.g. Hooker 1885, Gage 1903, Naithani 1984, 1990, Uniyal *et al.* 2007, Ohba *et al.* 2008) are also considered.

Results and discussion

Bistorta vivipara (Linnaeus) Gray (1821: 268)

Bas.: *Polygonum viviparum* Linnaeus (1753: 360). Type (Lectotype designated by Jonsell & Jarvis 1994: 154):—UNKNOWN ORIGIN: “*Habitat in Europae subalpinis pascuis duris*”, Linnaeus 510.4 (holotype LINN!).

Bistorta tenuifolia (Hsien Wu Kung) Futoshi Miyamoto & Hideaki Ohba (2005: 280) var. *tenuifolia*

Bas.: *Polygonum tenuifolium* Hsien Wu Kung (1935: 367). Type:—CHINA: Shensi, Near Pahsiantai Taipaishan, 3700 m, 5 August 1933, Wang W1846 (holotype PE!).

Bistorta tenuifolia (H. W. Kung) Miyam. & H. Ohba var. *gidarensis* I.D. Rai, G. Singh & G.S. Rawat, var. nov. Type:—INDIA. Uttarakhand: Uttarkashi, Gidara alpine meadow, 3852 m, 30°56'13.20"N, 78°36'16.48"E, 28 June 2010, Rai *et al.* 11543 (holotype WII!).

Diagnosis:—*Bistorta tenuifolia* var. *gidarensis* differs from *B. tenuifolia* in having the perianth lobes with acute apex, smaller stamens included in the perianth and monotheous reniform anthers.

Description:—Herb perennial (root stock), 5–20 cm high. Stem simple or in pair, erect or nearly so, pale green to green coloured; rhizome dark-brown, swollen, bulbous, covered with old leaf sheaths. Basal leaves 4–6, petioled (petiole 1.5–6 cm long), linear (2–15 × 0.1–0.2 cm) with acute apex, base narrowly decurrent, margin entire and revolute, upper surface glabrous, lower surface minutely hairy or glabrous, pale green; stipules 2–5 mm long, membranaceous, brown with acute apex; ocrea 1–3 cm long; cauline leaves 2–3, sessile, linear (2–4.5 cm long), apex acute, base narrowly decurrent, margin entire and revolute. Inflorescence in solitary cylindric raceme, 1.5–5 cm long; flowers white, solitary, with peduncle pale green to light brown (1.5–2.5 mm long); bracts (1.3–3 × 0.3–0.6 mm) lanceolate to oblong, membranous, apex acuminate to acute, pale brown; bracteoles (1–1.5 mm) membranous, lanceolate, apex acute; tepals 5 (1.7–2.2 mm long), oblong to oblanceolate, apex acute; stamens 8 with white filaments (0.5–1 mm long) and brown anthers (0.2–0.3 × 0.1–0.15 mm); brown coloured nectary glands at base of the stamen; pistil 2–4 mm long, styles 3 (1.5–3 mm long) white, connate at base, stigma capitate, brown, ovary trigonous to globose (0.5–1.25 mm long) narrowly lobed, dark-red to dark-pink; bulbil green to purple, 1.5–2.5 mm long, covered by bract and bracteoles; bulbil begin the develop from the basal part of the inflorescence before of the flowering; fruits and seeds unknown (Figs 1 and 2).

Ecology:—*B. tenuifolia* var. *gidarensis* grows on alpine meadows (especially along stream sides, mountain slopes in silty-loam soil) between 3600–4200 m a.s.l. The taxon occupied small areas (less than 15 sqm). The climate of the study area is characterized by three seasons: a short summer (May to June), monsoon (July to September) and prolonged winter (October to April, with a snowy covering of about five months), with temperature ranges between 25°C in summer and -15°C in winter. Flowering time is from June to August. The two varieties occur in different climatic conditions. Latitude, altitude and continental mass effect are the most influencing factors regulating the climatic attributes in the distribution area of these varieties across the Himalayan mountains and China. Due to the unique directions of monsoon from the Bay of Bengal and the Arabian Sea, Central Himalaya region (for var. *tenuifolia*) area is characterized by a continuous wet condition of the climate, while Western Himalaya (for var. *gidarensis*) remains comparatively drier due to delayed rainfall during summer.

Etymology:—The epithet *gidarensis* come from the *Gidara* alpine meadow in Uttarakhand.

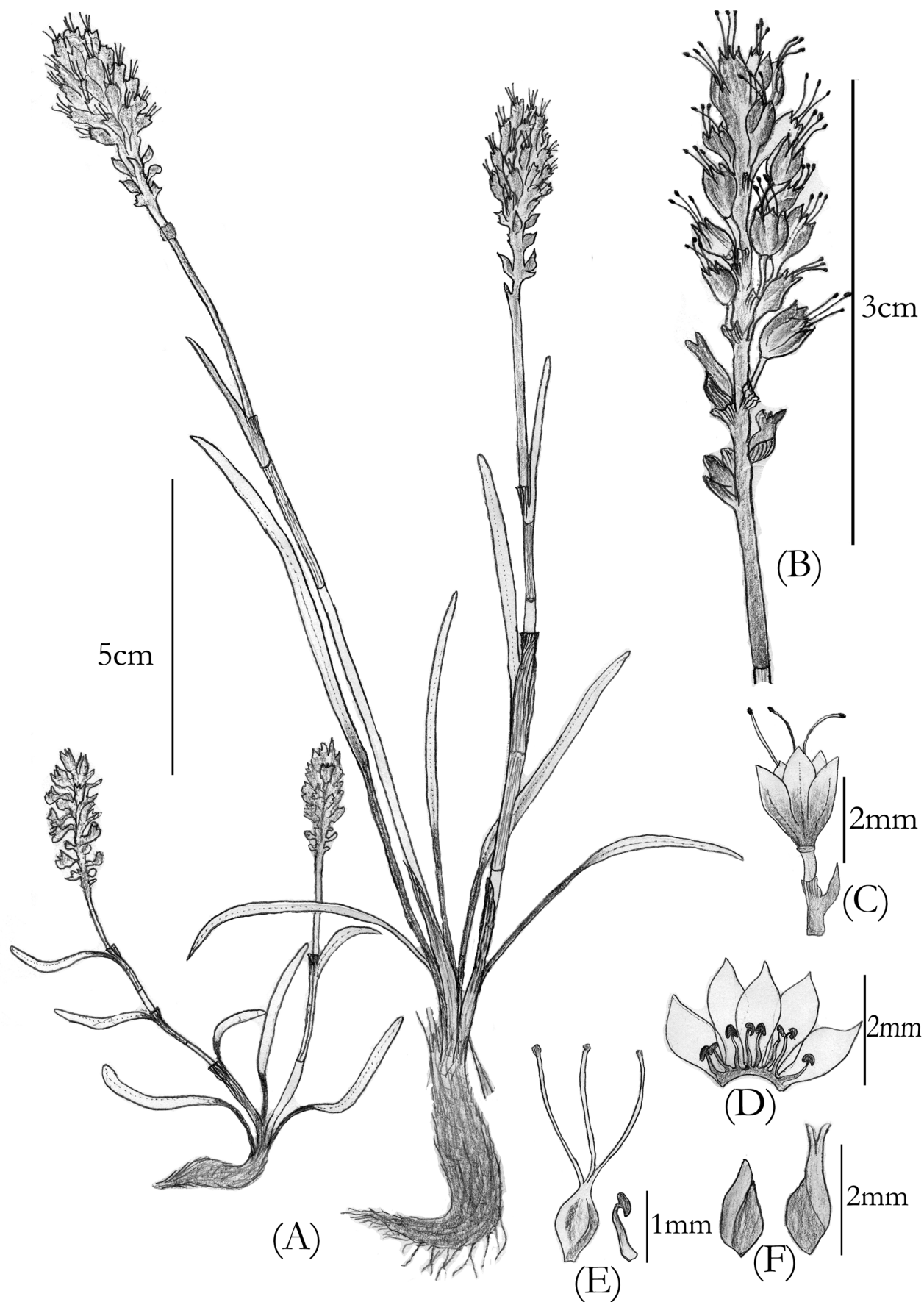


FIGURE 1. *Bistorta tenuifolia* var. *gidarensis* I. D. Rai, G. Singh and G. S. Rawat: A. Habit. B. Flowering branch. C. Flower. D. Perianth lobes with stamen. E. Pistil and androecium. F. Bulbils.



FIGURE 2. *Bistorta tenuifolia* var. *gidarensis* I.D. Rai, G. Singh and G.S. Rawat: A. Habit. B. Flowering branch. C. Flower. D. Perianth lobes with pistil. E. Perianth and androecium (brown spots). F. Perianth. G. Pistil and androecium. H. Bulbils.

Taxonomical notes:—The new variety mainly differs from *B. tenuifolia* s. s. in having perianth lobes with acute or acuminate apex (rounded in the nominal variety) and stamens 0.5–1 mm long (stamens 2–2.5 mm long in the nominal variety), included in the perianth and less than half of the total length of the perianth (exserted in the nominal variety). The presence of small dark red coloured ovary and long styles are also differences (see Table 1). The two varieties are allopatric [var. *gidarensis* from Western Himalaya, var. *tenuifolia* from Central Himalaya (Nepal) and China] which are distributed in different climatic conditions.

TABLE 1. Morphological comparison of *B. tenuifolia* var. *tenuifolia*, *Bistorta tenuifolia* var. *gidarensis* and *B. vivipara*.

		<i>B. tenuifolia</i> var. <i>tenuifolia</i>	<i>B. tenuifolia</i> var. <i>gidarensis</i>	<i>B. vivipara</i>
Habit/ length of flowering stem		Herb, perennial, ascendent to decumbent, 3–22 cm	Herb, perennial, erect, 5–20 cm	Herb, perennial, ascendant to erect, 10–30 cm
Basal leaves	Number	3–5	4–6	3–7
	Petiole length	0.5–3 cm	1.5–6 cm	2–6 cm
	Blade (length × width)	1–9 × 0.2–0.3 cm	2–15 × 0.1–0.2 cm	4–10 × 0.5–3 cm
	Blade margin	entire	entire and revolute	Minutely toothed, inrolled
Ocrea length		0.5–3 cm	1–5 cm	2–4.5 cm
Cauline leaves	Number	1–4	2–3	1–4
	Blade shape	Linear, upper sessile	Linear, upper sessile	Oblong to linear lanceolate
	Length	0.2–8 cm	2–4.5 cm	1–4 cm
Raceme length		1–3.5 cm	1.5–5 cm	2–6 cm
Bracts		1.3–3 × 0.3–0.6 mm	2.5–3.5 × 1–1.5 mm	2 mm
Number of flowers at each node		One	One	Two
Color of the flowers		White	White	Pale pink to white
Pedicel length		2–3.5 mm	1.5–2 mm	1–3 mm
Tepals	Number	5	5	5
	Length	2–3 mm	1.75–2.25 mm	2–3 mm
	Apex	Rounded	Acute to acuminate	Acute to obtuse
Stamens	Number and nature	8, exserted	8, included	8, exserted
	Filament length	2–2.5 mm	0.5–1 mm	2.5–3.5 mm
	Anther size	0.4–0.6 × 0.2–0.3 mm	0.2–0.3 × 0.1–0.15 mm	0.3–0.5 × 0.1–0.3 mm
	Anther type	Dithecous, simple	Monothecous, reniform	Dithecous, simple
Pistil length		2.5–3 mm	2–4 mm	1.5–4 mm
Styles	Number	3	3	3
	Length	1.8–2 mm	2–3.5 mm	2.5–3.5 mm
	Colour	white	white	White
Stigma structure		Capitate	Capitate	Capitate
Ovary	Length	1.8–2 mm	0.5–1.2 mm	1.5–2 mm
	Colour	pale green	dark red	Brown
Bulbil		1.6–2 mm	1.5–2.5 mm	2–3 mm

Conservation status:—The variety occurs in three localities in the Western Himalaya. Due to the peculiar habitat, the population is small (about 200 individuals). Three scattered population can be observed: the first one of about 40 individuals from Gidara, a second population of 10 individuals from Kanasar, and the third one of 150 individuals from GHNP. A strong anthropogenic impact (in the form of high grazing pressure), existing in the first two localities, might cause the decline or a local extinction of the taxon. On the basis of the IUCN Red List categories and criteria (IUCN 2011) the variety is evaluated as endangered (EN, D).

Additional Specimens examined:—**Nepal:** Miyamoto & *al.* 20210059, 20210045, 20210101 (2002, TI); **China:** T.P. Wang W1846 (1933, PE), T.T. Yu 12126, (1937, PE), Chen & *al.* 8167 (1884, PE), T.N. Liou & P.C. Tsoong 2899 (1939, PE); **India:** Uttarkashi district (Gidara, 3852 m, 30°56'13.20"N, 78°36'16.48"E; Kanasar, 3834 m, 30°53'41.41"N, 78°28'13.12"E), Uttarakhand and Great Himalayan National Park (Dhela, 3610 m, 31°45'26.62"N, 77°27'40.42"E), Himachal Pradesh.

Key for the viviparous species of *Bistorta* in the Himalayan region

1. Leaf blade oblong or ovate-lanceolate, 5–30 mm wide..... *B. vivipara*
- Leaf blade linear, 2–3 mm wide 2
2. Perianth with rounded apex, stamens exerted 2.0–2.5 mm long..... *B. tenuifolia* var. *tenuifolia*
- Perianth with acute apex, stamens included 0.5–1.0 mm long..... *B. tenuifolia* var. *gidarensis*

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