



# *Bromus catharticus* Vahl (Poaceae): a new plant record for Kashmir Himalaya, India

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**Abstract:** *Bromus catharticus* Vahl, a grass species native to South America, is newly reported here to the flora of Kashmir Himalaya, India. A detailed description and photographs of diagnostic features are provided to distinguish *B. catharticus* from allied species and authenticate this new record from this region.

**Keywords:** plant diversity; *Bromus catharticus*; Kashmir Himalaya; new distribution record

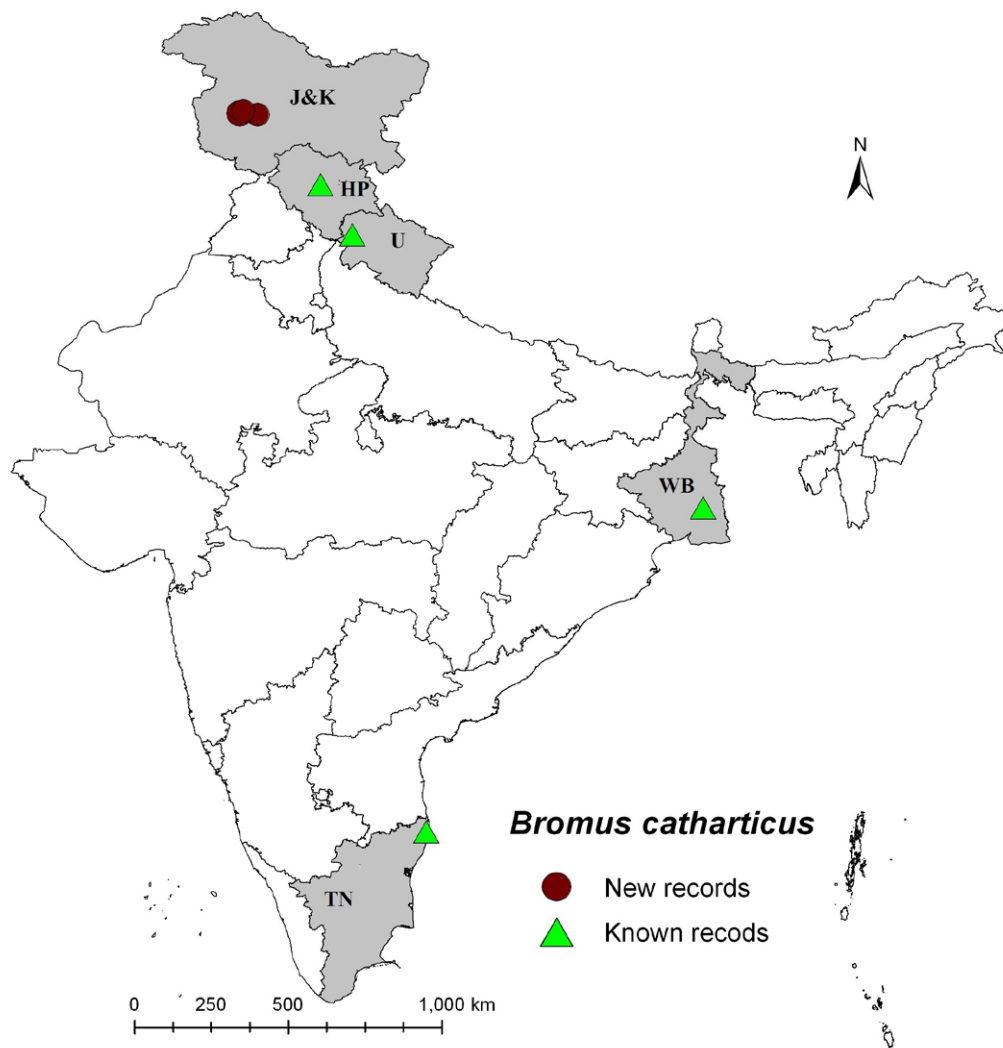
The genus *Bromus* L. (Poaceae: Bromeae) comprises of about 160 species (Acedo and Lamas 2001). The genus includes annual or perennial grass species with laterally compressed spikelets, unequal glumes, rounded or keeled lemmas, mostly awned, and palea generally smaller than lemma (Bor 1960). The genus is widely distributed in Asia, Europe, Africa, and the Americas (Watson and Dallwitz 1992). Hooker (1897) reported eight species of *Bromus* from India, i.e., *B. asper* Murray, *B. crinitus* Boiss., *B. himalaicus* Stapf, *B. inermis* Leyss., *B. mollis* L., *B. oxyodon* Schrenk., *B. scoparius* L., and *B. tectorum* L. Subsequently, Bor (1960) reported additional species of *Bromus* from India, including: *B. arvensis* L., *B. danthoniae* Trin., *B. diandrus* Roth, *B. gedrosianus* Penzes, *B. gracillimus* Bunge, *B. ramosus* Huds., *B. unioides* Kunth. Karthikeyan et al. (1989) provided a checklist of 15 species of *Bromus* in India.

From the Kashmir Himalaya, a region located in the northwestern Himalayas, Stewart (1972) recorded nine species of *Bromus*: *B. arvensis*, *B. danthoniae*, *B. gracillimus*, *B. inermis*, *B. japonicus* Thunb., *B. mollis*, *B. oxyodon*, *B. scoparius*, and *B. tectorum*. Of these, three species were recorded from subtropical Jammu province: *B. japonicus*, *B. mollis*, and *B. oxyodon* (Sharma and Kachroo 1981; Bhellum and Magotra 2012). Subsequently, Swami and Gupta (1998) reported two additional *Bromus* species from Jammu, namely *B. giganteus* L. and *B. pectinatus* Thunb.

During recent floristic surveys conducted from April

2014 to September 2014, while working on the flora of Srinagar city in the Kashmir Himalaya, we collected specimens of an unknown *Bromus* species. The species was growing commonly around dry road verges, wastelands, grassy embankments and pavement edges and formed abundant populations in the wild. On close examination of the specimens and using relevant taxonomic literature (Bor 1960), online e-flora illustrations and expert scrutiny, these were identified as *Bromus catharticus* Vahl, which has hitherto been unreported from this Himalayan region. Thus, this paper adds *B. catharticus* to the flora of Kashmir Himalaya. A description and photographs of diagnostic characters are provided to validate the new record and facilitate identification in the field.

This study was carried out in the city of Srinagar, located in the heart of Kashmir Himalaya (Figure 1). The Kashmir Himalayan region of India is within the north-western portion of the Himalayan biogeographic zone (Rodgers and Panwar 1988). It lies between 33°20'N to 34°54'N and 073°55'E to 075°35'E and covers an area of 15,948 km<sup>2</sup>. The elliptical and bowl-shaped Kashmir Valley is surrounded on all sides by high mountain ranges; the Middle or the Lesser Himalaya, also called the Pir Panjal Range, in the south and southwest separates the valley from the Jammu region, while the Great Himalayan Range in the north and east separates the valley from the Ladakh region. The altitude of the main valley ranges from 1,500 to 1,800 m above sea level. The Kashmir valley has a temperate climate. The precipitation is evenly distributed throughout the year and the region receives a mean annual rainfall of 710 mm. The hottest month is July (with mean minimum temperature of 18°C and mean maximum temperature of 30°C); the coldest month is January (with mean minimum temperature -2°C and mean maximum temperature of 5°C). Kashmir Valley has diverse soil types ranging from alluvial to lacustrine and glacial (Dar et al. 2001). The vegetation of the region is mainly comprised of temperate evergreen forests and alpine meadows (locally called



**Figure 1.** Location of previous and new records of *Bromus catharticus* in India (J&K = Jammu and Kashmir, HP = Himachal Pradesh, U = Uttarakhand, WB = West Bengal and TN = Tamil Nadu).

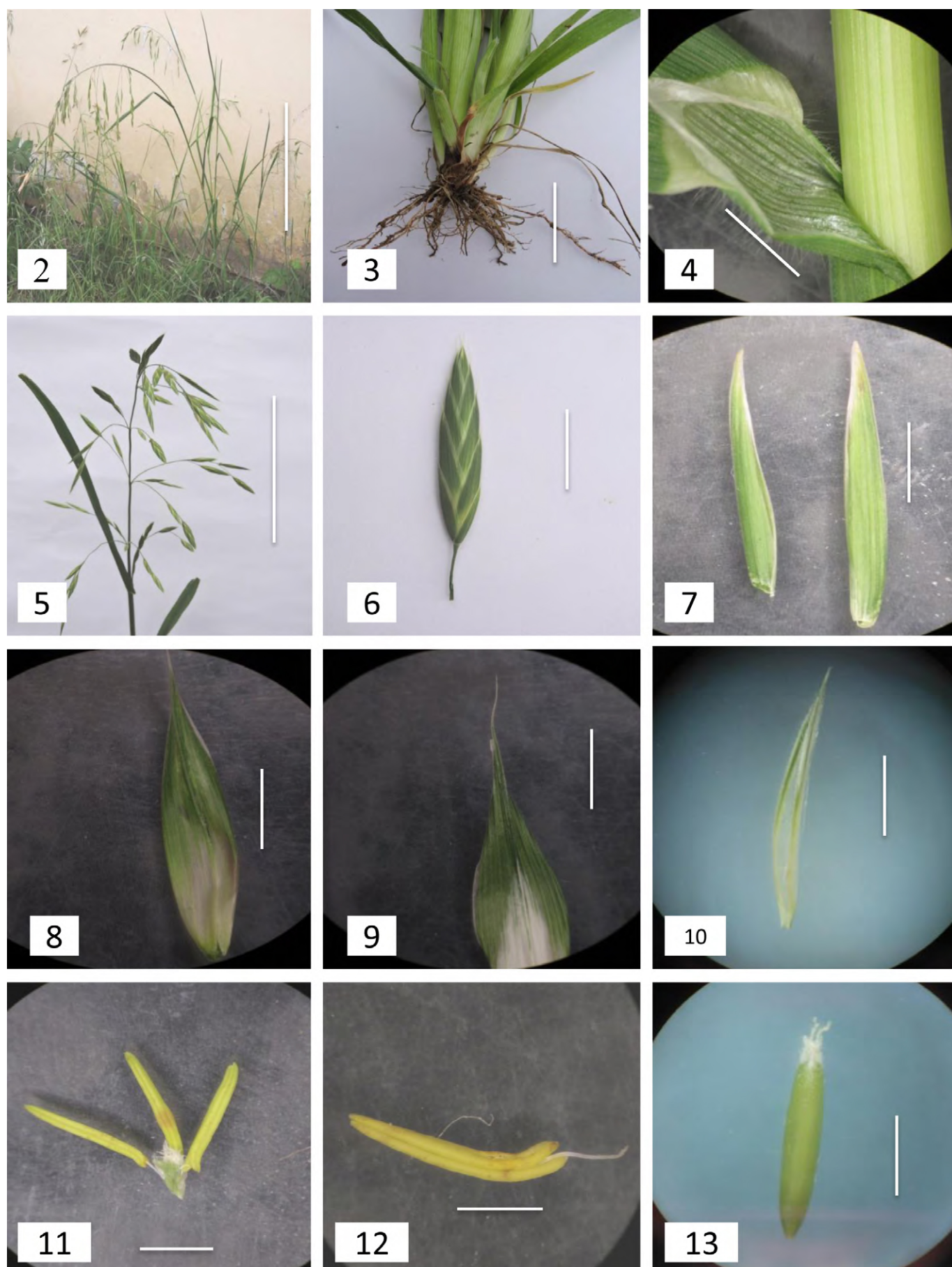
*margs*) confined to high altitudes (3,600 m to 4,000m above sea level; Dar et al. 2001).

Consultation of relevant taxonomic literature (Hooker 1897; Bor 1960; Stewart; 1972; Sharma and Kachroo 1981; Karthikeyan et al. 1989; Swami and Gupta 1998; Bhellum and Magotra 2012) as well as herbarium specimens of *Bromus* species deposited in the University of Kashmir Herbarium (KASH), allowed us to determine that *B. catharticus* was collected earlier (2012) in the Kashmir region but was misidentified at that time as *B. japonicus*. We also checked the Janaki Ammal Herbarium, Jammu but no record of *B. catharticus* was found therein (RRLH 2015). The newly collected specimens were deposited in the University of Kashmir Herbarium (KASH), Srinagar, India (voucher numbers KASH 79 and KASH 392).

***Bromus catharticus*** M.Vahl, Symbolae Botanicae 2: 22. 1791. Synonyms: *Bromus unioides* Kunth, *Bromus willdenowii* Kunth

English names: Grazing Brome, Rescue Brome, Brome Grass, Prairie Grass

Perennial herbs (Figures 2–13), caespitose; culms erect or ascending, 85–100 cm long. Roots fibrous. Leaf-blades 23–28 cm long and 5–8 mm wide; sheaths pilose and ligule translucent-membranous. Panicle terminal, oblong, lax, spreading, drooping, 10–40 cm long; panicle branches flexuous. Spikelets oblong-ovate, 18–40 mm long, borne on long peduncles up to 30 cm long, 6–12 flowered, strongly laterally compressed, the lemmas closely overlapping and concealing the short internodes of rachilla; glumes persistent, narrowly lanceolate, the lower glume 11–15 mm long, the upper one slightly larger than lower one, 12–18 mm long, acuminate; lemmas narrowly lanceolate, 15–20 mm long, 4–7 mm wide, laterally compressed and sharply keeled, green with hyaline margins, 9–13 nerved, scabrid on the nerves, minutely 2-toothed with up to 3 mm long awn; palea shorter than the lemma, keels ciliolate, 3–9 mm long. Lodicules 2. Anthers 3, yellow 3–5 mm long; ovary with



**Figures 2–13.** *Bromus catharticus* Vahl, (2) habit (scale=4cm), (3) roots (scale= 1cm), (4) leaf sheath and ligule (scale=2mm), (5) inflorescence (scale=1.5mm ), (6) spikelet (scale= 3mm ), (7) glumes (scale=1.5mm), (8) lemma (scale=1.6mm), (9) lemma with awn at tip (scale=0.2mm), (10) palea (scale=0.4mm ), (11) ovary and three anthers (scale=0.3mm), (12) anther (scale=0.4mm), (13) ovary (scale=0.6mm). Photos by M.Hamid.



dense pubescence at apex; plumose mass at the point of insertion of styles; stigmas 2, feathery. Caryopsis with palea, awned lemma and a rachilla segment attached to it at maturity, 10–16 mm long; hilum linear.

*Bromus catharticus* can be differentiated from its closely allied species *B. japonicus* by possessing diagnostic characteristic of oblong panicle with flexuous branches while the panicle of *B. japonicus* is ovate with effuse branches. Additionally, the fertile spikelets of *B. catharticus* are laterally compressed and ovate, while as those of *B. japonicus* are ovate-lanceolate. Both lemma and glumes of *B. catharticus* are distinctly keeled, while in *B. japonicus* only the glumes and not the lemma are keeled.

#### Identification key:

- 1a Plants annual, upper glume apex acute ..... 2
- 1b Plants perennial, upper glume apex obtuse or acuminate ..... 3
- 2a Spikelets cuneate, fertile lemma lanceolate, glumes dissimilar and keeled ..... *B. tectorum*
- 2b Spikelets ovate, fertile lemma elliptic, glumes similar without keel ..... *B. japonicus*
- 3a Leaf-sheath pubescent, fertile lemma keeled ..... *B. catharticus*
- 3b Leaf-sheath glabrous, fertile lemma without keel ..... *B. inermis*

*Specimens examined:* India: Jammu and Kashmir: District: Srinagar, Peer Bagh, 13 May 2014, I. Muzafar and A.A. Khuroo 79 (KASH); Eidgah, 8 June 2014, I. Muzafar and A.A. Khuroo 392 (KASH); Shalimar, 11 May 2012, A.H. Malik and A. A. Khuroo 39094 (KASH).

Currently, *B. catharticus* commonly forms dense populations along roadsides and in open spaces in the Kashmir region. The flowering period stretches from April to July. Some associated species include *Lolium temulentum* L., *Poa annua* L., *Hordeum murinum* L., *Trifolium pratense* L., *Medicago sativa* L., *Galium aparine* L. and *Capsella bursa-pastoris* (L.) Medik. Although the species is native to the South American countries of Venezuela, Brazil, Bolivia, Columbia, Ecuador, Peru, Argentina, Chile, Paraguay, and Uruguay, it has been widely introduced to and naturalized in Europe, Africa, Asia, Australia, and North America (Newell 1973). In India, the species has also been reported from the states of Himachal Pradesh (northern India), Uttarakhand (northern India), Tamil Nadu (southern India) and West Bengal (eastern India) (Bor 1960; Chowdhery and Wadhwa 1984; Gaur 1999; Kabeer and Nair 2009). The present paper now newly records this species from state of Jammu and Kashmir, a geographical range extension of ca. 500 km northwest of the nearest previous record in the state of Himachal Pradesh (Chowdhery and

**Table 1.** Previous and new records of *Bromus catharticus* in India. Geographic coordinates use the datum WGS84.

Area/State	Coordinates
Peer Bagh (Jammu and Kashmir)*	34.063° N, 075.316° E
Eidgah (Jammu and Kashmir)*	34.104° N, 074.794° E
Shalimar (Jammu and Kashmir)*	34.162° N, 074.907° E
Himachal Pradesh	31.131° N, 077.172° E
Uttarakhand	30.550° N, 078.100° E
Tamil Nadu	13.083° N, 080.266° E
West Bengal	22.566° N, 088.366° E

\*New records of the species.

Wadhwa 1984) (Figure 1; Table 1). It is most likely that the seeds of this species have reached unintentionally as contamination with *Avena sativa* L. (Oats) in the Kashmir valley.

Auld et al. (2003) have reported *B. catharticus* as an invasive species with widespread distributions in both Japan and southeastern Australia. It is likely that this non-native species may turn out to be a potentially invasive in the Himalayan region and its presence may require immediate attention from land managers and environmental policy makers. Already, this species has escaped into the wild and is spreading fast into natural areas where it forms dense populations along roadsides, open areas and embankment slopes. Since this species is potentially invasive, so the spread of this species in this ecologically fragile biodiversity hotspot of Kashmir Himalaya (Myers et al. 2000; Chitale et al. 2014) will require continuous assessment and monitoring in future.

#### ACKNOWLEDGEMENTS

We thank the Head of the Department of Botany, University of Kashmir, for providing facilities necessary for this study. The kind help provided by support staff at the Centre for Biodiversity and Taxonomy, University of Kashmir, and the preparation of map by Dr. C. Sudhakar Reddy (National Remote Sensing Centre, Indian Space Research Organization, Hyderabad) is acknowledged. We also acknowledge the helpful suggestions by two anonymous reviewers, the editor, Dr. Guilherme Seger, and the copy editor, Robert Forsyth.

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- Author contributions:** IM collected the plant material; IM, AAK, GM and MH worked out the identification of the species; IM, AAK and IR wrote the manuscript and MH photographed the specimens.
- Received:** 11 July 2015
- Accepted:** 6 April 2016
- Academic editor:** Guilherme Dubal dos Santos Seger