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RESEARCH ARTICLE

Reassessing endemism: Distribution of *Microstegium falconeri* (Poaceae: Andropogoneae) beyond its known habitats

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Abstract

Biodiversity hotspots are invariably rich in endemic flora and fauna. The Himalayan region, in particular, has long attracted botanists and field taxonomists due to its remarkable floristic diversity. However, recurring questions arise - are endemic species truly restricted in their distribution? Insufficient studies in classical systematic taxonomy, along with limited field exploration in biodiversity-rich regions, often lead to misconceptions about endemism. Such a situation was observed in the case of *Microstegium falconeri* (Hook.f.) Clayton conducted extensive surveys between 2000 and 2024 across different parts of the Himalaya. This study documented the extended distribution of *M. falconeri*, a species previously considered endemic to Himachal Pradesh and Uttarakhand. The species has now been reported from other Indian regions, including Jammu & Kashmir and neighbouring countries such as China and Nepal, with an earlier record from Bhutan. The paper provides a comprehensive taxonomic account of the species, including detailed descriptions, illustrations, colour photographs from natural habitats, geo-coordinates of collection sites and notes on flowering and fruiting periods. Notably, this work also reports the recollection of *M. falconeri* from Himachal Pradesh after more than a century. Furthermore, it highlights the species' habitat preferences, distribution patterns and conservation status while assessing potential threats to its survival across varied ecosystems. Such a study underscores the importance of continued field-based taxonomic exploration and cautions against the uncritical use of the term "endemic". True endemism must be reassessed through extensive fieldwork and modern analytical approaches, as existing literature may not always present the complete picture of a species' rarity or distribution.

Keywords: conservation; Himalaya; *Ischnochloa*; Nepal; recollection; threatened

Introduction

Endemic species draw global scientific attention due to their restricted distribution and limited populations, making them vital components of biodiversity research. Botanists and field taxonomists are often deeply interested in such species, which are frequently encountered by chance during exploration. Discovering these taxa beyond their previously known ranges is both rare and valuable, as it helps bridge existing gaps in biodiversity knowledge and supports conservation planning (1). Within the Poaceae family, however, identifying such species remains challenging because of their subtle morphological variations, the specificity of their habitats and the low likelihood of encountering them in the wild.

A notable example arose from extensive field surveys conducted over 24 years (2000-2024) across the Central and Western Himalayas, the Eastern Himalayas, Nepal and parts of Tibet, China. During these explorations, *M. falconeri* was predominantly observed in mossy, moisture-retaining habitats-typically shaded forest slopes, damp ravines and areas near perennial water channels. These microhabitats maintain a stable moisture regime throughout the growing season, suggesting a strong ecological affinity of this species with humid, shaded environments. The present study documents an expanded distribution range and provides new insights into the population structure of *M. falconeri*.

The genus *Microstegium* Nees is presently categorized under the sub-tribe Saccharinae (2) of the tribe Andropogoneae (3) within the subfamily Panicoideae of the family Poaceae. It stands apart from other genera of the tribe Andropogoneae due to its narrowed leaf base, similar pairs of sessile and pedicelled spikelets arranged in single to several digitate to subdigitate racemes, glumes of equal length to the spikelet enveloping the florets, with the upper floret awned from the sinus of the bifid lemma (3-5). The genus comprises approximately 24 species distributed globally, with the main populations primarily found in tropical to subtropical regions of Africa, Asia, Australia and some Pacific islands (5-6). At present, four species of *Microstegium* are reported in Nepal (7-8), while 13 taxa are documented in China (9) and a total of 9 taxa are recorded in India (10-11).

Several in-depth studies consistently highlight that this species is predominantly confined to the North-Western Himalayan region, specifically in Himachal Pradesh and Uttarakhand (11-15). On the other hand, its occurrence from "*Mussoorie to Simla*" with a range extending from the "*Submontane to montane Himalayas from*

Garhwal to Shimla" has been documented (3, 16). Some sources in the literature specifically assert that it is endemic to the Garhwal region and Mussoorie, Uttarakhand, meaning it is exclusively found within these limited areas (13, 17). Other sources propose that its endemism extends to the entire state of Uttarakhand, indicating that the species is native to and limited within the entire state of Uttarakhand as a whole (18). In contrast, its endemism is restricted to the Jaunsar-Bawar region, extending to the Mussoorie hills in the Western Himalayas (19). The first report from the Kumaon region was made in Nainital in 1978, expanding the distribution further eastwards (20). Subsequently, several collections were made not only in and around the type localities in Garhwal but also from Bageshwar and Pithoragarh districts of Kumaon, thus further extending its distribution to the Nepal border. The species was also reported in several floristic studies (21-22) and also formed part of the floral checklists of management plans in the forest department's management plans (23). The species occurs in the Eastern Himalayas; however, no specimen has been reported from the region (24). Conversely, the first record of this species beyond its previously known range was in Trongsa district near Shemgang in Bhutan, where only a single specimen was observed (25). Its probable occurrence had been speculated in Western Nepal due to its distribution in Uttarakhand and Himachal Pradesh. Still, it was noted that it had not yet been reported elsewhere in Nepal (25).

In July 2014, as part of the Kailash Sacred Landscape Conservation Initiative an international transboundary cooperation project spanning India, Nepal and China, led by International Centre for Integrated Mountain Development (ICIMOD), Kathmandu, an unusual species of *Microstegium* was collected at a place called Tatopani, near the Nepal-China border in Sindhupalchok district in Bagmati Province (26). The River Kosi forms the natural boundary between the two countries at this place. The same species was also found growing on the roadside walls of the border town of Zhangmu across the Kosi River in Nyalam County, Xizang Province, China (26). Specimens were later collected from Dharchula in India's Pithoragarh district and the neighboring town of Khalanga in Nepal's Darchula district, Sudurpaschim Province, across the Kali River (26). Similarly, between July 2023 to late September 2024, this unfamiliar *Microstegium* species was documented during extensive field surveys conducted by the first author as part of doctoral research across the Indian North-West Himalaya, covering Uttarakhand, Himachal Pradesh, Jammu & Kashmir and Ladakh. The plant was found in a mossy, shaded habitat near water channels. The species was recorded during an extensive study on the grasses of the Western Himalayas. This species was characterized by acute or acuminate leaf blades that taper towards the base, with both surfaces sparsely hispid, membranous and ciliate ligule, usually single racemes with flattened and glabrous rachis, ciliate callus present in both sessile and pedicelled spikelets and a perfect geniculate awn arising from the sinus of bifid upper lemma. This specimen was identified as *Microstegium falconeri*.

The presence of *M. falconeri* has not been previously recorded in Nepal according to existing literature (7, 8, 27-30) as well as China (5, 9). Similarly, it is new to the flora of Jammu & Kashmir, where its occurrence has not been reported (10, 11, 31-33). Notably, this study reports the recollection of *M. falconeri* in Himachal Pradesh after 122 years. This study also marks the first recorded occurrence of this species in Nepal, within the Central Himalayas, as well as in Tibet, China and in the Indian regions of Jammu & Kashmir in the North-West Himalayas.

Materials and Methods

Field surveys were conducted across different parts of the Himalayas, including the Central Himalayas (Nepal), Tibet and the Western Himalayas encompassing Uttarakhand, Himachal Pradesh and Jammu & Kashmir, during the period 2000-2024. Through an extensive review of taxonomic literature, several ambiguities were identified regarding the distribution, rarity status and taxonomic interpretation of *M. falconeri*. These included contradictory reports on its geographic range (being described as endemic versus narrowly distributed across Himalayas), inconsistent assignment of its conservation status (variously treated as rare, indeterminate or vulnerable) and past misidentifications with morphologically similar species such as *Arthraxon lancifolius*, *A. microphyllus* (3, 5, 10-15). To resolve these issues, the protologue (34) and other relevant taxonomic references (3, 35-40) were critically examined to clarify its habitat and diagnostic features. The taxonomic identification of M. falconeri was based on a detailed examination of its morphological and reproductive structures, as well as a review of relevant literature (2-5, 31, 36, 39). Geo-referenced maps (Fig. 1A), created using QGIS Version 3.36.2, are included to depict both the collection sites and previously reported locations. To facilitate identification, a comprehensive species description is provided, along with colour photographs (Fig. 1B-F) and illustrations (Fig. 2). A comprehensive examination of herbaria, including K, WII, DD, BSD, CAL, GUH and the DAV college herbarium, confirmed the species' distribution throughout the Himalayan region (41). The herbarium specimens have been securely deposited in the WII and DD herbaria.

Results

Microstegium falconeri (Hook.f.) Clayton, Kew Bull. 35(4):816 (1981).

≡ *Ischnochloa falconeri* Hook.f., Hooker's Icon. Pl. 25:t. 2466 (1896).

≡ *Pogonatherum falconeri* (Hook.f.) Roberty, Boissiera 9:396 (1960).

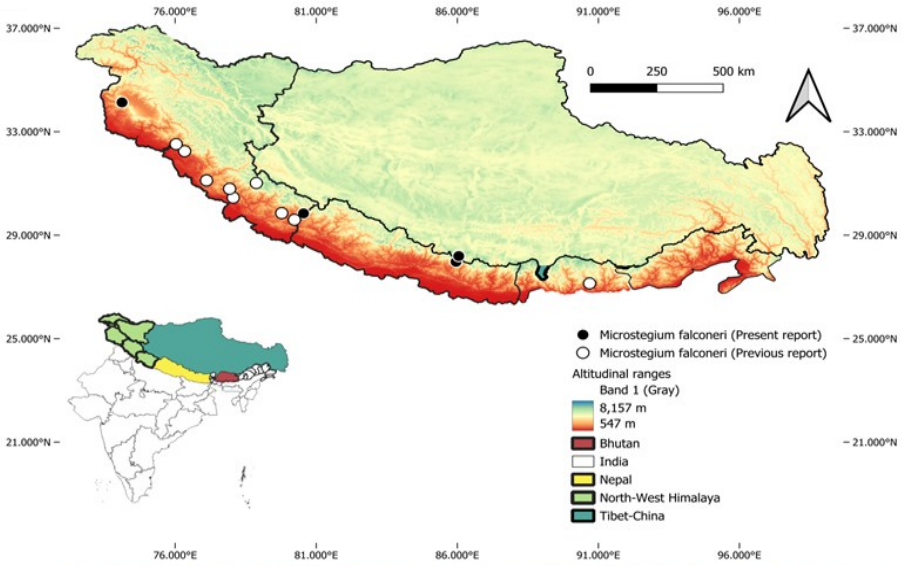
Type

India: North-Western Himalayas, growing amongst moss, *Falconer s.n.* [K000245602 (digital image!]; The protologue mentions that "*Unfortunately, the specimens are unaccompanied by any note of locality, which is presumably the North-Western Himalayas, where Dr. Falconer travelled extensively and collected largely*". One of the specimens on this sheet shows the plant is growing on moss, as also mentioned in the publication (37).

Taxonomic history

The taxonomic journey of *M. falconeri*, particularly its type specimen, is quite fascinating, involving various names over time. The type specimen is based on a collection by Hugh Falconer, likely gathered during his tenure as superintendent of the Saharanpur Botanical Garden from 1832 to 1841 (34, 37). The herbarium specimens were deposited at Kew Herbarium, though the type specimen lacks precise dates. Initially, in 1871, the specimen was identified as *Batratherum micans* due to its resemblance to *Arthraxon* (formerly known as *Batratherum*). Later, in August 1889, C.B. Clarke identified it as an unknown species of *Andropogon*. Finally, J.D. Hooker described it as *Ischnochloa falconeri* in 1896, based on Falconer's collection. In the Flora of British India (1897), the occurrence of *I. falconeri* was reported from

(A)



(B.i)

(C)

(B.ii)

(B.iii)

Fig. 1. *Microstegium falconeri* (Hook.f.) **(A)**. Map depicting the place of collection; **(B.i)**. Natural habitat at Dharamshala, Himachal Pradesh, India (32.24212864328795° N 76.3500002801737° E); **(B.ii).** Natural habitat at Darah Goolan, Jammu & Kashmir, India (34.12876788026067° N 74.10862677111984° E); **(B.iii).** Natural habitat at Tatopani, Nepal (27.97870944162811° N 85.93085794646281° E); **(C)**. Habit; **(D)**. Inflorescence; **(E)**. Leaf sheath and leaf blade; **(F)**. Sessile and pedicellate spikelet.

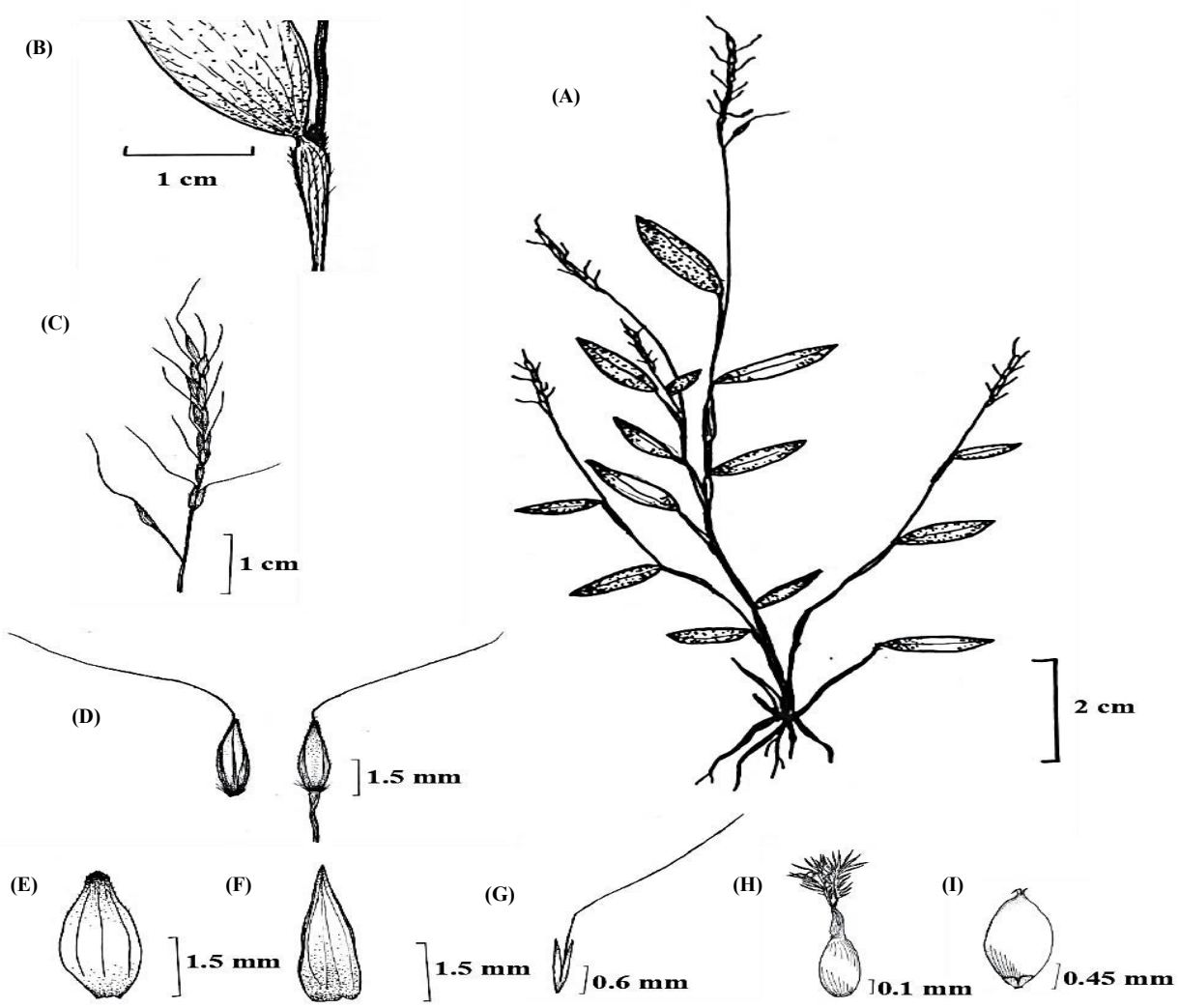


Fig. 2. Illustration of *Microstegium falconeri* (Hook.f.): **(A)**. Habit; **(B)**. Portion showing leaf sheath and leaf blade; **(C)**. Inflorescence; **(D)**. Sessile and pedicellate spikelet; **(E)**. Upper glume; **(F)**. Lower glume; **(G)**. Lemma; **(H)**. Ovary and feathery stigma; **(I)**. Caryopsis.

the North-Western Himalayan regions, though no detailed herbarium records were provided. The DD herbarium houses one of the oldest collections. Subsequent references included this species, citing Falconer and Gamble (K27208, Mussoorie, September 1898) (3). It was later transferred to the genus *Pogonatherum* (38). Finally, in 1980, William Derek Clayton reclassified it under its current name, *M. falconeri*, as a new combination (39).

Morphological description

Annual, caespitose. Culms 10-25 cm, decumbent, glabrous; nodes pubescent. Leaf-sheaths 0.5-3 cm, ciliate. Ligule 0.1-0.35 mm, ciliate, membranous. Leaf-blade 0.5-10 cm × 0.3-2 cm, lanceolate, flat, sparsely hairy, margins entire, base pointed, apex acute. Inflorescence 2-4 cm, solitary spiciform-raceme, rarely with a second branched raceme; spikelets paired, one sessile, one pedicelled, uniform, hermaphrodite, awned, with ciliate callus. Rhachis 1-4 mm, linear, flattened, filiform; margins thickened, glabrous; sessile spikelet 2.5-4 mm × 0.5-1 mm, lanceolate, puberulous. Lower glume 2.5-4 mm, linear-oblong, coriaceous, minutely ciliate, muticous, 5-6 nerved, margins inflexed, apex truncate. Upper glume 2.5-4 mm, oblong, acute, muticous, 3-nerved, margins curved inwards, ciliate toward the apex, apex truncate. Lower floret absent, sterile or rudimentary. Lemma 1-2 mm, glabrous, 2-lobed, tip incised to one-third to one-half of the lemma; awn 4-10 mm, arising from the sinus of the lemma, geniculate. Palea absent or minute. Pistil 1.4-1.6 mm; ovary 0.35-0.45 mm, style short, free, bifid; stigma 2, feathery. Anthers 3, 1-1.3 mm, oblong. Caryopsis 1.70-1.85 mm, brown, elliptical-lanceolate. Lodicules 2, up to 0.15 mm, fleshy, cupuliform, membranous, glabrous.

Chromosome number

n = 20 (41).

Flowering and fruiting

July - October.

Distribution

India: Himachal Pradesh, Uttarakhand, Jammu & Kashmir (Present report); Nepal & China (Present report), Bhutan.

Habitat

Typically found on hilly slopes, thriving in moist conditions and often growing alongside mosses or near water channels in shaded areas, at elevations ranging from 1400 m to 2500 m above msl. However, isolated populations were also found at 850 m altitude and 3100 m altitude in a similar habitat.

Specimens examined

Nepal: Sindhupalchouk district, Tatopani, elevation 1950 m, 27.97870944162811° N 85.93085794646281° E, July 7, 2014, KSLCDI project, *Manoj Chandran*, 010302 (WII!); Darchula district, Khalanga, elev. 850 m, 28.72768280126835° N 82.20421811225387° E, August 10, 2010, KSLCDI project, *Manoj Chandran*, 5650 (WII!). CHINA, Tibet (Xizang), Nyalam County, Zhangmu, elev. 2000 m, 27.986201128062344° N 85.98764427835602° E, July 23, 2014, KSLCDI project, *Manoj Chandran*, 010303 (WII!). INDIA, Jammu & Kashmir, Baramula district, Darah Goolan, on the way to NH1, elev. 1420 m, 34.12876788026067° N 74.10862677111984° E, September 24, 2024, *Kuntal Saha*, 224 (DD!).

India: Uttarakhand, Below Mussoorie, Tehri-Garhwal, 30.452201184445727° N 78.06013085949819° E, September, 1898, *J.S.Gamble*, 003645800 (K!); Nainital District, Balrampur, 29.395140327710738° N 79.4419343832985° E, September 16, 1937, *HG Champion*, 003645795 (K!); Tehri District, Surkanda devi, 30.406209152234137° N 78.28875955859337° E, August 15, 2000, *Manoj Chandran*, 5255 (DD!); Chamoli district, Badrinath, elev. 3100 m, 30.74071793233071° N 79.49105854489926° E, August 1, 2003, *Manoj Chandran*, 2524 (DD!); Bageshwar district, Loharkhet, September 11, 2003, *Manish Kandwal*, (DAV college herbarium!); Pithoragarh district, Bagudiar, Munsyari, 30.07088310846258° N 80.23404598189789° E, September 19, 2005, *Manish Kandwal*, 4767, (DAV college herbarium!); Uttarkashi District, On way to Taluka, Govind Pashu Vihar WLS, 31.07818861576873° N 78.24680510442053° E, September 18, 2009, *R. Manikandan*, 123344 (BSD!); Dehradun district, Mussoorie, 30.46531819039663° N 78.06534704748528° E, August 17, 2023, *Kuntal Saha*, 174092 (DD!); Tehri Garhwal, Dhanaulti, 30.401475488575382° N 78.23476791160176° E, September 11, 2023, *Kuntal Saha*, 174270 (DD!); Dehradun district, on the way to Kharamba peak, Chakrata, Jaunsar, 30.80608731913947° N 77.93579443160792° E, September 1, 2023, *Kuntal Saha*, 174338 (DD!).

Himachal Pradesh, Shimla, 6500 ft, September 9, 1901, JA Lace, 003645799 (K!); Kangra district, Dharamshala, on the way to Bhagsu Nag waterfall, 32.247319147375926° N 76.33771200989895° E, September 16, 2023, *Kuntal Saha*, 174274 (DD!); Dharamshala, on the way to Triund, 32.24212864328795° N 76.3500002801737° E, September 17, 2023, *Kuntal Saha*, 174269 (DD!).

Taxonomic note

Several studies as well as our field observations have shown that *M. falconeri* shares a similar growth habit and external appearance with *Arthraxon lancifolius* (Trin.) Hochst. and it is often found growing nearby (25, 40). As a result, many herbarium specimens have been mistakenly identified as *A. lancifolius* or *A. microphyllus* (Trin.) Hochst. A herbarium specimen of *M. falconeri* collected near Shemgang (Trongsa district), Bhutan, was incorrectly identified as *A. microphyllus* (25). However, its morphology differs distinctly from that of any *Arthraxon* species. *A. lancifolius* (Table 1) has a largely cosmopolitan distribution at altitudes of 800–1700 m, while *M. falconeri* is primarily found in moist areas at elevations between 1500 and 2500 m. However though isolated collections from 850 m and 3100 m also exist. Unlike *Arthraxon* species, which display multiple racemes, *M. falconeri* has a single racemose spike. Additionally, *Arthraxon* leaves have an amplexicaul base, whereas *M. falconeri* leaves taper at the base. Conversely, *M. falconeri* shares morphological resemblances with *Microstegium butuoense* Y.C.Liu & H.Peng, a grass native to China, but differs from the latter by its glabrous pedicels and very dwarf nature, reaching a maximum height of 20 cm, whereas *M. butuoense* possesses ciliate pedicels and reaches heights above 30 cm (Table 1). *M. butuoense* primarily thrives in the high altitude of alpine meadows, showcasing its preferred habitat within these elevated and extreme conditions (4). In contrast, *M. falconeri* is found mainly in the sub-tropical to temperate regions of the Himalaya. *M. falconeri* was characterized by glabrous nodes, leaves and a basal sheath (5). However, our observations revealed finely ciliate leaf margins and a hairy mouth on the basal sheath. Furthermore, the upper surface of the leaf remained green, while the underside had a reddish wine coloration.

Table 1. Comparative morphological differences between *M. falconeri*, *A. lancifolius*, *A. microphyllus* and *M. butuoense*

Character	***Microstegium falconeri* (Hook.f.) Clayton**	***Arthraxon lancifolius* (Trin.) Hochst.**	***Arthraxon microphyllus* (Trin.) Hochst.**	***Microstegium butuoense Liu & Peng***
Habit	Annual; culms erect or decumbent, 20-50 cm	Annual; slender, trailing, 10-30 cm	Annual; rambling, slender, 15-30 cm long	Annual; culms decumbent, slender, 35 cm long; nodes bearded
Culms	Glabrous, rooting at lower nodes	Slender, trailing; occasionally rooting	Slender, ascending	Slender, hispid; lateral branches ample
Leaf-sheaths	Glabrous or sparsely pubescent	Hispid, with short hair	Glabrous or scaberulous	Hispid, with tubercle-based hairs
Ligule	Ciliolate membrane, 1-2 mm long	Ciliate membrane, short	Ciliolate membrane, 0.4-2.5 mm	Eciliate membrane, 0.9 mm long
Leaf-blades	Lanceolate to narrowly ovate, 2-5 cm × 3-8 mm	Lanceolate to narrowly ovate, 1-3 cm × 3-7 mm	Lanceolate or ovate, 0.3-1.7 cm × 1-4 mm	Lanceolate or elliptic, 0.7-2 cm × 2-5 mm, hispid on both sides
Leaf apex	Acute to acuminate	Acute	Acute	Acute
Inflorescence	2-4 racemes, 2-4 cm long, digitate	1-3 racemes, 0.5-2 cm long, not terete, greenish-yellow	1–3 racemes, 2.8–3.9 cm long	Single raceme, 2-3.5 cm long
Rachis	Fragile, filiform, ciliate	Fragile, short hairs < 0.5 mm	Pubescent, hairs 1–2 mm	Tough, ciliate on margins; internodes linear, 4.5 mm
Sessile spikelet	3-4 mm long, laterally compressed, awned	3-5 mm long, linear, flat on back, awn 7-10 mm	2.8–3.9 mm long, lanceolate, awn 7–11 mm	Lanceolate, dorsally compressed, 5.2–6 mm long, pubescent callus
Pedicelled spikelet	Present, shorter than sessile	1.5-2 mm long, sometimes suppressed	1.9–2.2 mm long	Present, linear pedicel; equal in length to the sessile spikelet
Lower glume	Chartaceous, 6–7-veined, scabrous above	Flat, linear, scaberulous	Chartaceous, 6-veined, scaberulous	Linear-lanceolate, 5 mm long, 4–5-veined, coriaceous, obtusely 2-keeled
Upper glume	3-veined, keeled, acute apex	Flat, produced into short awn (0.5-1.5 mm)	Lanceolate, 3-veined, acute apex	Elliptic, 5.5 mm long, 1-keeled, apex acuminate
Lemma (fertile floret)	Lanceolate, awned; awn 8-10 mm	Lanceolate, awned; awn 7-10 mm	Lanceolate, awned; awn 7-11 mm	Oblong, 3–3.5 mm long, hyaline; 2-fid apex, awn 6–9 mm long, geniculate and twisted
Sterile lemma	Absent or minute	Present, hyaline, 3-4 mm	Small, hyaline	Lanceolate, 4 mm long, hyaline
Palea	Minute or absent	Minute	Minute	1 mm long, apex ciliate
Anthers	2; 0.5-0.6 mm long	2; 0.4-0.6 mm long	2; ~0.6 mm long	2; 0.6 mm long
Spikelet fall	Disarticulating below the glumes	Persistent	Persistent	Falling entire
Habitat	Moist shaded slopes, mossy rocks (1800-2600 m)	Grassy slopes, rocky banks (1500-2000 m)	Moist shady slopes (1800–2500 m)	Forest margins and rocky slopes (China, 1600-2200 m)
Distribution	Western Himalayas, Nepal, Bhutan, China	Africa to India, China and Indonesia	China, India, Indo-China, Malesia	China (Yunnan)

Discussion

M. falconeri was previously classified as "rare" based on limited records, while others listed it as indeterminate (12, 42). It is currently categorized as vulnerable (24). However, after conducting extensive surveys across various parts of the Himalaya, our findings suggest that this species is not restricted solely to Uttarakhand and Himachal Pradesh but is instead distributed across the broader international Himalayan region. Presently, within the Himalayas, its occurrence extends from the subtropical to the temperate zones, at altitudes ranging from 850 m (Dharchula) to 3100 m (Badrinath).

Its apparent rarity in herbarium collections is likely due to its brief flowering and fruiting period-from early August to late September-and its diminutive stature, which allows it to remain concealed within surrounding vegetation. Furthermore, in the field, *M. falconeri* closely resembles *A. lancifolius* (Table 1) in moist habitats, often leading to misidentification or being overlooked (25, 40). Despite its ecological significance, *M. falconeri* has remained poorly understood for more than a century, largely due to anthropogenic disturbances and habitat degradation observed during field surveys.

Limestone quarrying, road widening and the construction of cemented retaining and breast walls on steep slopes have contributed significantly to habitat loss. The species typically grows in association with mosses along moist, shaded slopes and near perennial water channels-microhabitats that are highly sensitive to environmental disturbance. In addition, the invasion of non-native species such as *Erigeron karvinskianus* DC. has further deteriorated its natural habitats. The ephemeral nature of this grass, combined with its brief reproductive phase, contributes to its vulnerability and conservation concerns.

Before initiating conservation actions, it is essential to prioritize the documentation of the species' presence and incorporate these findings into floral checklists and forest department management plans. For ensuring the long-term conservation of *M. falconeri*, site-specific restoration and protection of its unique microhabitats are essential. Conservation efforts should focus on safeguarding populations occurring in mossy, moisture-retaining slopes and riparian zones, while restricting activities such as quarrying and roadside construction. Regular removal of invasive species like *Erigeron karvinskianus* is crucial to reduce competition and habitat degradation. Setting up small-scale nurseries for ex-situ propagation, along with engaging local communities in awareness and monitoring initiatives, can greatly strengthen conservation efforts for *M. falconeri* and similar species. Together, these actions will help stabilize existing populations and promote the natural regeneration of *M. falconeri* and related taxa throughout their native Himalayan range.

Conclusion

The present study serves as an eye-opener for botanists throughout the Himalayan region, prompting them to reassess the distribution status and threat status of this species. The findings suggest that the species may be found across all the Himalayan and adjoining high-altitude ranges from Pakistan to Myanmar. Hence, more exploration, especially during July to November, may reveal the distribution of this species in the whole Himalayan range, connecting the present isolated locations. Therefore, further exploration, particularly during July to November, could help uncover its presence across the entire Himalayan range, bridging the currently known isolated locations.

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Authors' contributions

MC and KS conceptualized and designed the study, carried out material preparation, data collection and analysis and drafted the initial manuscript, with all authors contributing valuable feedback and revisions to earlier versions. RN supervised the overall study and facilitated access to the herbarium. SG provided essential support during field surveys. All authors reviewed and approved the final version of the manuscript.

Compliance with ethical standards

Conflict of interest: The authors do not have any conflicts of interest to declare.

Ethical issues: None

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