Taxonomic studies and new distribution records of three grass species from Himachal Pradesh, North-West Himalaya

Kuntal Saha
kuntalsaha121@gmail.com
Shri Guru Ram Rai University
Manoj Chandran
Uttarakhand Forest Department
Ranjana Negi
Forest Research Institute
Saurabh Guleri
Shri Guru Ram Rai University

Short Report

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Abstract

Comprehensive documentation of regional floristic diversity is essential for advancing botanical knowledge. The present study enhances the agrostological and ecological understanding of Trans-Himalayan region by documenting the taxonomic identification and new distribution records of *Poa eleanorae*, *Poa palustris*, and *Secale segetale* from Himachal Pradesh for the first time. These documentations significantly extend the known distribution ranges of these grasses and underscore the critical role of field-based exploration in under-surveyed alpine landscapes such as the Pangi Valley. While *Poa eleanorae* has been successively collected across Bhutan, Nepal, Uttarakhand, and now Himachal Pradesh, *Poa palustris* demonstrates naturalization patterns in remote areas with minimal anthropogenic influence, suggesting ecological adaptability and dispersal through unintentional pathways. The recollection of *Secale segetale*, last documented 53 years ago, highlights its fragmented and restricted populations in India, calling for systematic surveys and conservation interventions. Through detailed taxonomic descriptions, habitat observations and distributional notes, this study contributes to clarifying species' occurrences while emphasizing the broader implications of climate change, human-mediated dispersal, and habitat vulnerability in Himalayan ecosystem. The findings highlight the need for sustained botanical exploration in Himalaya, reveal notable gaps in knowledge of its grass flora, and illustrate the process by which an introduced species can become naturalized.

INTRODUCTION

Mountain biodiversity hotspots are ecologically critical yet highly fragile, harboring numerous threatened and endemic species [1]. The Western Himalaya, a major part of the Himalayan Biodiversity Hotspot, encompasses the Pangi Valley—a cold arid region marked by rugged terrain, low precipitation, harsh climatic conditions, and heavy snowfall [2]—where grasses play a vital role in sustaining ecosystem stability. Despite their importance, grass diversity in this region remains poorly explored. Recent field survey in the alpine meadows and adjoining areas of the Pangi Valley documented two perennial *Poa* taxa with lax panicles, together with an annual *Secale* taxa characterized by its fragile spike rachis, spikelets 2-floreted; glumes very narrow, subulate, 1-veined [3].

The genus *Poa* L., the largest grass genus, is predominantly distributed in temperate to alpine zones [4]. As the type genus of the family Poaceae [4], *Poa* is taxonomically complex, often requiring detailed microscopic examination of characters such as the callus, glumes, lemma, palea, anther and other diagnostic structures [5]. In contrast, *Secale* L., though comparatively small, is of significant agronomic value but is notoriously difficult to identify due to its limited diagnostic characters [6].

Both genera were first established by Carolus Linnaeus (1707–1778), widely regarded as the "Prince of Botanists" [7], whose taxonomic legacy remains foundational even today. In his *Species Plantarum* (1753), Linnaeus described *Poa* with 11 species, which has now expanded to 582 worldwide [8], while *Secale*, initially represented by four species, currently comprises nine taxa [8], among which cultivated rye (*S. cereale*) is the most significant. Both cultivated rye and its wild relatives provide essential genetic

material for improving wheat, especially in enhancing its resistance to stress [9]. Today, the genus *Poa* is placed within tribe Poeae [10] or Festuceae [3], while *Secale* belongs to subtribe Hordeinae [9] of tribe Triticeae [3, 10] both genera are placed under the subfamily Pooideae of Poaceae.

During the our course of study, one of the two *Poa* taxa was identified as *Poa eleanorae* Bor, characterized by spikelets approximately 6.5 mm long, pubescent callus, lemma hairy in lower half or less, and the lowest lemma reaching 4 mm [3, 4, 11]. This species belongs to *Poa* subg. *Poa* [11], the largest and most diverse subgenus, comprising annual and perennial, with or without rhizomes, typically with the uppermost culm sheaths closed for more than one-quarter of their length. The second taxa was confirmed as *Poa palustris* L., commonly called late meadow grass, distinguished by webbed lemma callus, obscure side nerves, and brown or copper streak beneath the hyaline lemma tips. It is placed under *Poa* subg. *Stenopoa* [11], whose members usually possess extravaginal shoots, are mostly rhizomeless, and have uppermost culm sheaths closed for approximately 1/15–1/5 (–1/4) of their length. Hybridization and facultative apomixis are common within both *Poa* subg. *Poa* and *Poa* subg. *Stenopoa* [11]. The *Secale* taxa were identified as *Secale segetale* (Zhuk.) Roshev, characterized by glumes with acuminate or shortly awned apices, awns shorter than lemma and rachis of spike that is fragile or occasionally tough proximally [12, 13].

Interestingly, a critical review of earlier studies [3, 4 14–17] revealed that these three taxa represent new distributional records for the flora of Himachal Pradesh. Their documentation marks the first record of these species in the Trans-Himalayan region and underscores the ongoing range expansion of plants into the high-altitude landscapes of the Himalaya.

MATERIALS AND METHODS

In 2024, field surveys were carried out across various elevational ranges, from the Shivaliks to alpine meadows and the cold desert, to assess grass species diversity. As part of this extended floristic study, explorations were made in Pangi Valley [18]—a remote, high-altitude tribal region renowned for its natural beauty, situated between the Pir Panjal ranges and Zanskar ranges of North-West Himalaya [19]. Geographically, the valley lies in northwest part of Chamba district, bordered by Lahaul & Spiti in the south and east, and Jammu & Kashmir to the north. Elevations range between 1,975m and 6,400m, with the average peak height around 5,181m [20]. The valley is nourished by Chenab River and its glacial-fed tributaries, and has a semi-arid climate, with cool summers receiving little monsoon rain and harsh, prolonged winters marked by heavy snowfall [19]. Snow accumulation often blocks passes for four to five months, leaving residents isolated [18]. The species was identified by consulting the type specimen [K000789633, LINN 87.21; acronyms as per 21], the protologue [22, 23], and relevant taxonomic studies [3, 4, 11–13]. Detailed species descriptions are provided along with colour image (Figure.1), photoplates (Figure. 2, 3, 4) not available in earlier works or the protologue. The voucher specimens (Fig. 5) have been deposited in herbarium of Forest Research Institute, Uttarakhand (DD herbarium).

RESULTS

The present investigation documents the taxonomic identification and new distributional records of three grass species from Himachal Pradesh, a region noted for its ecological diversity and remarkable floristic endemism [15]. Detailed taxonomic accounts, type details, habitat information, distributional notes, and mapping (Fig. 6) are provided to substantiate their occurrence.

Poa eleanorae Bor, Kew Bull. 3(1): 142 (1948). (Figs. 1. A-B, 2,5A)

Type: Sikkim: Northeast Sikkim, August 1893, *Dr. H. A. Cummi*. [K000789631 (digital image!)].

Perennial, loosely tufted. Culms 10–50 cm × 1–2 mm, erect to ascending, sometimes geniculate at base, smooth, glabrous, 2–3 nodes. Leaf sheaths glabrous, loose, smooth. Leaf blades 5–25 cm × 1–4 mm, linear, convolute, abaxially shiny, smooth, adaxially scabrid, margins nearly smooth. Ligules upto 3 mm, truncate to obtuse, glabrous. Panicle 6–30 × 3–12 cm, lax; branches 2 per node, spreading, flexuose, scabrid distally, longest bearing 5–15 well-spaced spikelets. Spikelets 6–7 mm, cuneate, 4–5-floreted; rachis scabrid; rachilla internodes 1.5–1.7 mm, pilulose; rachilla extensions 0.8–1.1mm, pilulose. Upper glumes 3.5–4.5 mm, 3-nerved, acuminate, smooth, with hyaline margins. Lower glume 3–3.5 mm, 1-nerved, acute, smooth, with hyaline margins. Lemmas 4–6.5 mm, elliptic, acute, 5-nerved, scabrid throughout; keel shortly villous on lower third, marginal veins sometimes ciliate below. Palea upto 2.5mm, keels scabrid. Callus sparsely webbed. Lodicules 2. Anthers 0.6–1.2 mm, 3. Caryopsis not seen.

Flowering & Fruiting

July–October.

Habitat

Along moist and water-logged alpine meadows and grassy habitats, between 3000–3300 m.

Distribution: INDIA: Sikkim, Uttarakhand, Himachal Pradesh (Present Study); Bhutan; Nepal.

Specimen Examined

India, Himachal Pradesh, Chamba Dist., Pangi Valley, enroute to Chasak Bhatori, 32°57'32"N & 76°34'57"E, 3194 m, 04.08.2024, *Kuntal Saha* 175093-DD.

Poa palustris L., Syst. Nat., ed. 10. 2: 874. 1759. (Figs. 1. C-D, 3,5B)

Lectotype: “Habitat [in Helvetiae, Italiae paludibus.] Sp. Pl., ed. 2. 1: 99. 1762.” Lectotype: Herbarium No. 87.21 (LINN) [24].

Perennial, tufted. Culms 40–90 cm, erect or slightly geniculate at base, branched near base; nodes 5–6, dark brown; internode green, scabrid. Leaf sheaths 8–18 cm × 2–4 mm, smooth, equal to or shorter than blade; blades flat, glabrous, apex boat-shaped. Ligule 2–3 mm, membranous. Panicle 10–25 cm, slightly contracted, branches obliquely ascending, 3–7 per node, basal branch ½–⅔ as long as panicle. Spikelets

5–6.5 mm × 2–2.5 mm, ovate-oblong; rachis scabrid. Upper glumes 4–4.5 mm, 3-nerved, acute, glabrous. Lower glumes 3.5–4 mm, 1-nerved, acute, glabrous. Florets 5.5– 6 × 1.5–2 mm, with 2–5 florets, green; callus webbed; rachilla ciliate. Lemma 3–4 mm, membranous, keels and marginal veins shortly villous on lower half, apex golden-hyaline. Palea 3–3.5 mm, glabrous, membranous, keels scabrid. Anthers 1.2–2 mm, yellow; stamen 3. Caryopsis 2–3 mm, dark drown.

Flowering & Fruiting

June–September

Habitat

Along water channels, in sandy and partially moist meadows, among scattered thickets on slopes at 3100–3300 m elevation.

Distribution: INDIA: Jammu and Kashmir, Uttarakhand, Himachal Pradesh (Present Study); North America; Europe; Greenland; Alaska; China; Korea; Central Asia.

Specimen Examined

India, Himachal Pradesh, Chamba Dist., Pangi Valley, Sahli village, 32°59'28"N 76°31'53"E, 2915 m, 03.08.2024, *Kuntal Saha* 175092-DD.

Secale segetale (Zhuk.) Roshev., Ref. Nauchno-Issl. Rabot, Otd. Biol. Nauk 1944: 5 (1945).

(Figs. 4,5C)

Annual, tufted. Culm 20–70 cm, erect, glaucous, glabrous; node 3–4, dark brown. Leaf sheath glabrous, shinning. Leaf blades 20–35 × 0.5–0.8 cm, flat, scabrous adaxially. Ligule 1–2 mm, membranous. Inflorescence 4–13 × 1–3 cm, simple spike; rachis fragile, sometimes tough at base, margins ciliate. Spikelets 12–15 mm, solitary at each node, lanceolate, 2–3-flowered. Glumes 9–12 mm, glabrous, keels shortly scabrous-ciliate, apex acuminate or awned (up to 5 mm). Lemma 8–12 mm, long-lanceolate, glabrous, scabrous; awn 20–70 mm. Palea equal to lemma. Caryopsis obovoid, adherent to pericarp; hilum linear.

Flowering & Fruiting

May–August.

Habitat

along cereal fields, especially wheat, thriving in well-drained, fertile soils of temperate regions.

Distribution: INDIA: Jammu and Kashmir, Himachal Pradesh (Present Study); Afghanistan, China (Xinjiang), Iran, Iraq, Kazakhstan, Kirgizstan, North Caucasus, Pakistan, Tadzhikistan, Transcaucasus,

Turkmenistan, Uzbekistan.

Specimen Examined

India, Himachal Pradesh, Chamba Dist., Pangi Valley, on Saichu road, near govt. school, 32°59'07"N 76°33'37"E, 2646 m, 04.08.2024, *Kuntal Saha* 175094-DD.

DISCUSSION

Biodiversity loss and species redistributions represent among the most critical ecological challenges of the present era. In fragile alpine ecosystems, such changes often occur rapidly due to a combination of natural and anthropogenic drivers, including habitat alteration, climate variability, and the introduction of non-native taxa [25]. The Himalaya, recognized as one of global biodiversity hotspot [1], supports rich floristic diversity, including several rare, endemic, and little-known grasses. Yet, the flora of many high-altitude landscapes remains underexplored, resulting in major knowledge gaps regarding species distributions and ecological dynamics. Sustained botanical exploration in such regions is essential, as it not only strengthens floristic inventories but also aids in the timely detection of naturalized alien plants that may exert ecological impacts.

This study enriches the floristic knowledge of the Trans-Himalayan region by documenting *Poa eleanorae, Poa palustris, and Secale segetale* in Himachal Pradesh for the first time. Such records extend the known distribution ranges of the taxa and underscore the importance of field-based assessments in remote alpine valleys such as Pangi valley. Successive collections of *Poa eleanorae*, described by Dr. Norman Loftus Bor and named in honor of his wife, Eleanor Constance [23], was later praised by him as “a very fine species with large spikelets” [3]. After its earlier reports [8, 23] from the eastern and central Himalaya, the present recollection from Himachal Pradesh provides new insights into its occurrence in the northwestern Himalaya and emphasizes the value of continued botanical exploration in clarifying the ranges of little-known grasses. Similarly, *Poa palustris*, originally described from the marshlands of Switzerland and Italy, introduced in India through Kashmir, where it was cultivated as a fodder grass [26]. It was later documented in Uttarakhand from Badrinath, en route to Mana (3100 m, 1995, Nautiyal 14927, GUH). In Himachal Pradesh, the species is now confirmed from several sites (Fig. 6), particularly between 2900–2950 m a.s.l., with two stable populations recorded in the Pangi Valley near Sahli village. The route of its introduction into this remote valley appears to have been unintentional, yet its establishment is noteworthy. The occurrence of *P. palustris* in Pangi Valley—an isolated landscape with limited tourism and absence of major highways—raises important ecological questions about dispersal pathways and mechanisms of establishment. Earlier reports [3, 4] mention the species within the 3100–3300 m belt, mostly in meadow habitats, while our observations reveal populations thriving at slightly lower altitudes along roadside verges, where suitable microhabitats are created. This suggests considerable ecological flexibility and highlights its ability to establish in novel habitats. Such adaptability strengthens evidence for its naturalization in Himalaya habitats, where the species has formed self-sustaining populations, disperses beyond the original point of introduction, and integrates

into the local flora, thereby fulfilling the widely accepted definition of naturalization (Richardson *et al.*, 2000).

Secale segetale noted as an agricultural weed, often associated with wheat fields [11], yet it remains poorly documented in India. Earlier study [28] (specimen RAW 26701) reported its occurrence in grain fields of Gilgit, Kashmir, and another study [3] mentioned that cautioned that its admixture with wheat flour could be detrimental. An earlier study [12] also emphasized the need to monitor its spread in Kashmir's agricultural landscapes. The present recollection represents only the second record of *S. segetale* from India, rediscovered after a gap of more than five decades. Extensive botanical surveys across the Himalaya, supported by herbarium consultations [BSD, DD, CAL, KASH, PLP, HBJU; acronyms following 21], indicate that its Indian populations are highly localized and fragmented. In view of earlier concerns [12], systematic field investigations are now required to clarify its precise distribution and to evaluate the potential risks it may pose to native agro-ecosystems.

These findings collectively illustrate how incompletely documented the alpine flora of Himachal Pradesh remains. They also indicate that ongoing climatic shifts and human-mediated factors may be facilitating the persistence and spread of alien grasses in fragile mountain systems. The naturalization of alien taxa such as *P. palustris* demonstrates their ecological flexibility, while rediscoveries like that of *P. eleanorae* & *S. segetale* highlight the vulnerability of under-surveyed landscapes to overlooked or re-emerging weeds. Both scenarios pose potential long-term risks to native biodiversity.

Thus, the present study not only enriches agrostological knowledge by documenting rediscovery and new recollections of overlooked grass taxa in the Trans-Himalaya, but also provides essential baseline information for understanding their ecological roles and potential risks of naturalization. By bridging taxonomy with field ecology, these findings highlight the dual importance of systematic documentation and ecological assessment in fragile alpine environments. Sustained efforts combining comprehensive surveys, herbarium-based validations, ecological monitoring, and local community engagement are imperative to clarify species distributions, detect early signs of naturalization, and mitigate potential invasive threats. At the same time, policy-level interventions promoting integrated conservation frameworks will be crucial to safeguard the floristic uniqueness of Himalaya. Linking rediscovery with long-term ecological vigilance, this approach ensures not only the advancement of grass systematics but also the preservation of biodiversity and stability of high-altitude Himalayan landscapes for future generations.

Declarations

Ethics approval and consent to participate

The collection of plant material for this study was conducted in accordance with applicable local and national regulations, and no additional formal authorization was required. All the wild grass specimens were collected following prior official correspondence or verbal approval from the Divisional Forest Officer (DFO) and the concerned wildlife authorities of the respective forest divisions in Pangi Valley,

Chamba, Himachal Pradesh. No specific permit or license number was issued, as the work complied with regulatory guidelines and did not involve any threatened or legally protected species. Relevant details of the forest divisions and wildlife sanctuaries are documented on the herbarium labels of specimens deposited in the DD Herbarium.

Plant guidelines

The collection of plant materials was carried out in accordance with all applicable institutional, national, and international guidelines and legislation.

Consent to publication

Not applicable.

Declaration of Competing Interest

The authors declare that they have no conflict of interest

Plant reproducibility

All three grass species were collected from different localities within Pangi Valley, Chamba District, Himachal Pradesh. The specimens were identified by the authors (M. Chandran and K. Saha), and voucher specimens have been deposited in the Forest Research Institute Herbarium (herbarium code: DD).

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Author Contribution

All authors contributed equally.

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Availability of data and materials

All data generated or analysed during this study are included in this published article files.

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Figures

Figure 1

(A-B) *Poa eleanorae* Bor & (C-D)*Poa palustris* L.: A. Habitat near dry roadsides; B. Close-up of inflorescences; C. Habit near the water channel; D. Close-up of inflorescences.

Figure 2

Dissection plate of *Poa eleanorae* Bor. (A-T): A. Habit; B. Portion of internode; C. Inflorescence; D. Scabrid tips of leaf blade; E. Glabrous upper surface of leaf blades; F. Node; G. Spikelets; H. Ligule; I. Floret; J. Rachilla extension; K. Upper glume (lateral & dorsal view); L. Scabrid rachis; M. Pubescent callus; N. Arrangement of florets in rachilla internodes; O. Lemma (dorsal & lateral view); P. Lemma margins ciliate in the lower half; Q. Lower glume (lateral & dorsal view); R. Palea; S. Anthers; T. Pistil.

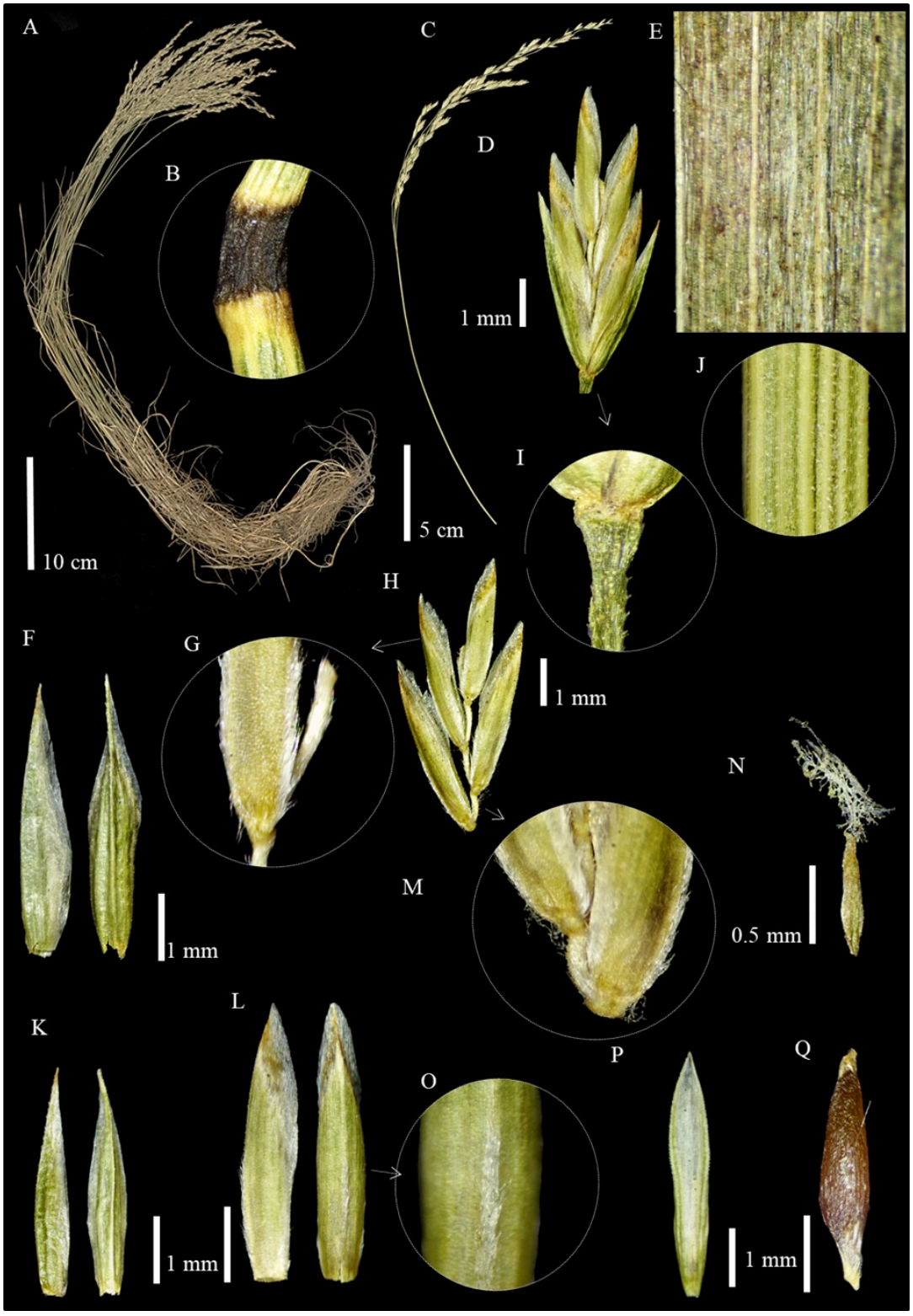

Figure 3

Dissection plate of *Poa palustris* L. (A-Q): A. Habit; B. Node; C. Inflorescence; D. Spikelet; E. Upper surface of leaf blade; F. Upper glume (lateral & dorsal view); G. Pubescent rachilla extension; H. Floret; I. Scabrid rachis; J. Portion of internode (scabrid); K. Lower glume (lateral & dorsal view); L. Lemma (lateral & dorsal view); M. Close-up of callus; N. Pistil; O. Ciliate keel of lemma; P. Palea; Q. Caryopsis.

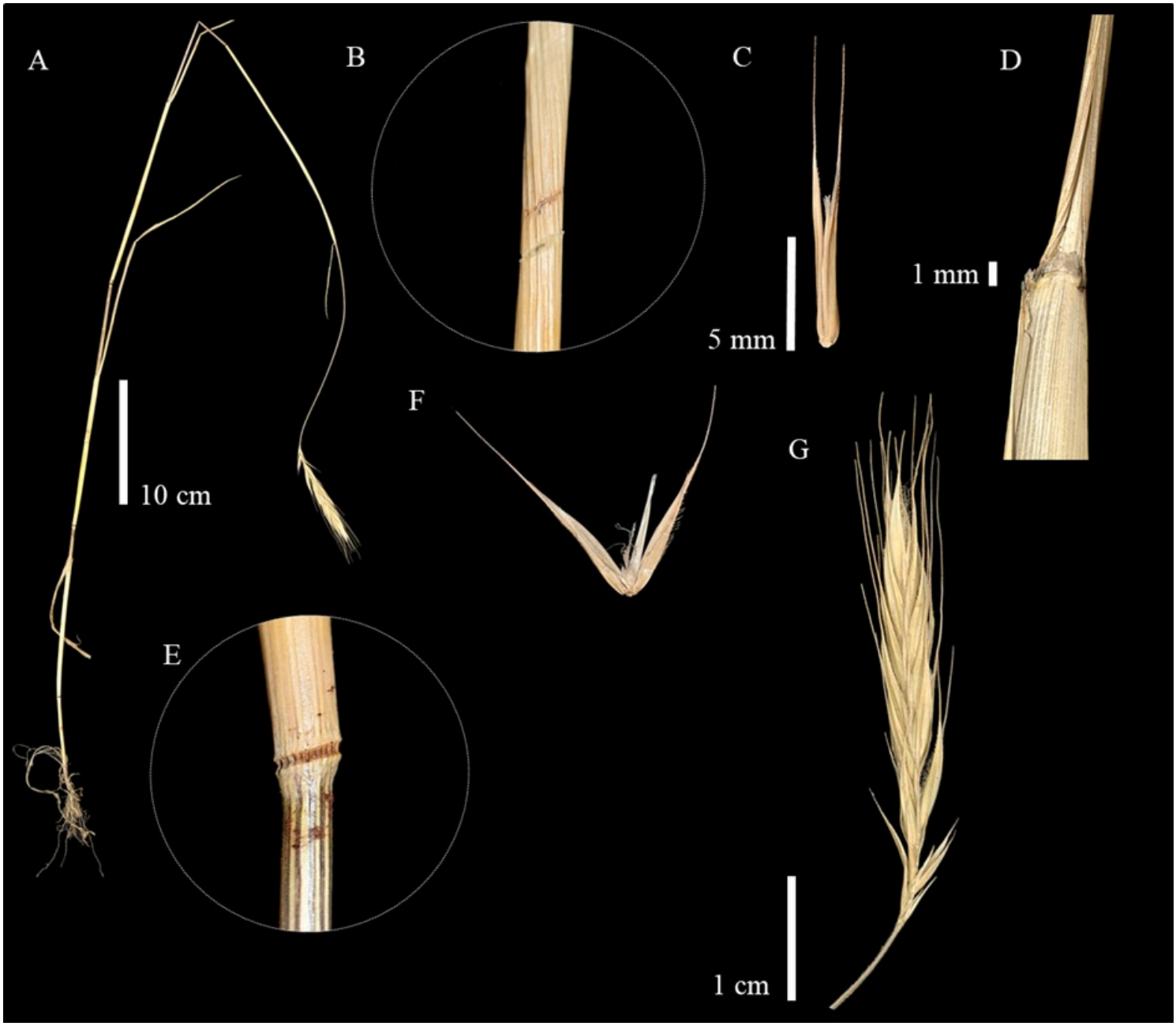

Figure 4

Dissection plate of *Secale segetale* (Zhuk.) Roshev. (A-G): A. Habit; B. Portion of internode; C. Spikelets; D. Ligule; E. Node; F. Spikelet Split open of spikelets; G. Inflorescence.

Figure 5

Herbarium specimens (DD herbarium) of A. *Poa eleanorae* Bor; B. *Poa palustris*; C. *Secale segetale* (Zhuk.) Roshev.

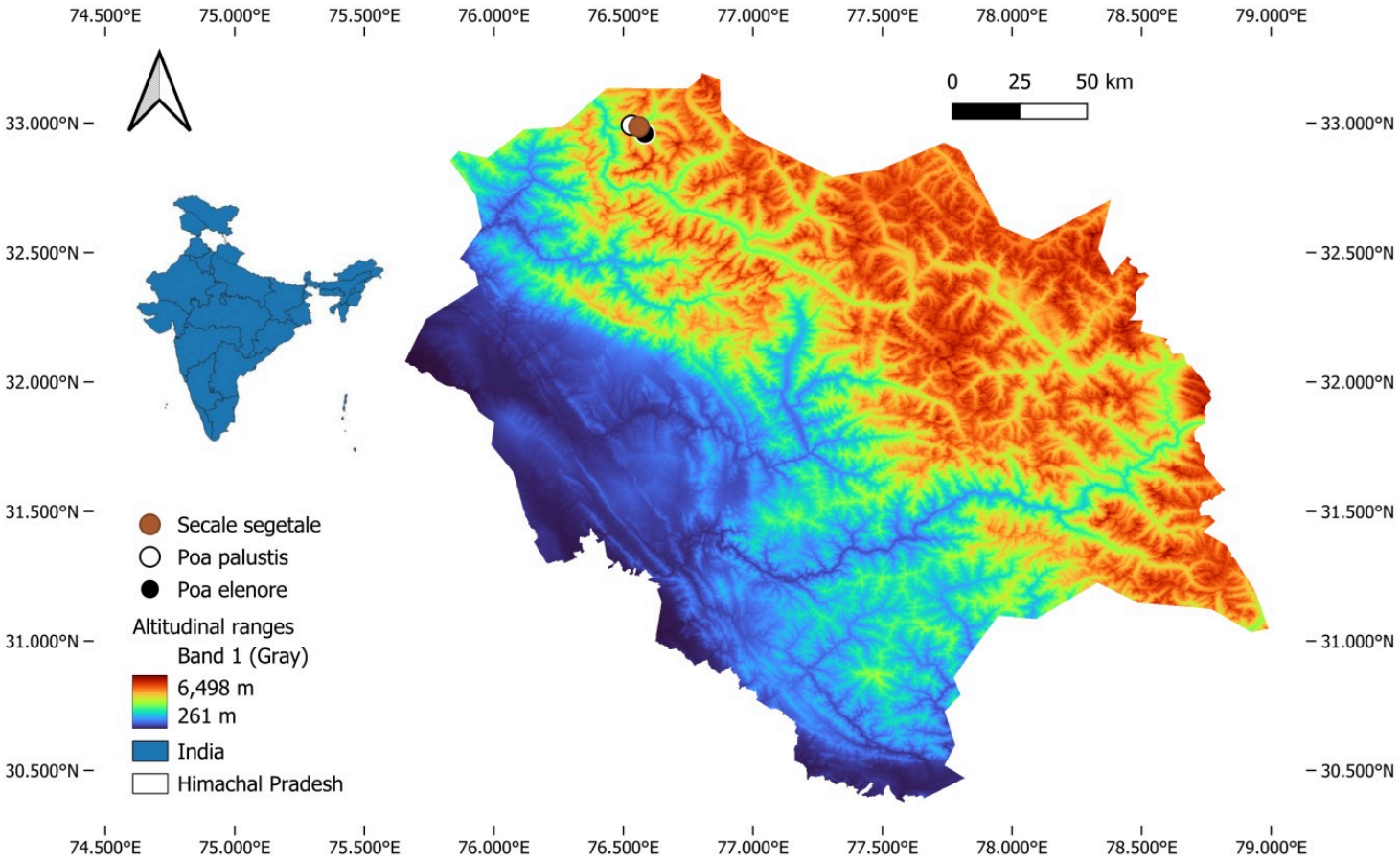

Figure 6

Map illustrating the newly recorded distribution of three grass species.