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Research Article

Checklist of family *Poaceae* in Lahaul and Spiti district (Cold Desert), Himachal Pradesh, India

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Abstract

The present study provides an overview of the diversity and distribution of grass species in Lahaul- Spiti district (cold desert) situated in the Trans-Himalayan region i.e. Himachal Pradesh, India. From the study area 141 taxa (138 species and 3 subspecies) belonging to 14 tribes were recorded. The largest tribe was Festuceae followed by Agrostideae having 48 and 20 species, respectively. Two species *Poa koelzii* and *P. Lahaulensis* are endemic to Lahaul- Spiti. *Puccinellia kashmiriana* is rare as per IUCN status. The present study on the grass floral wealth of Lahaul-Spiti provides an important baseline data on grasses for further quantitative and qualitative investigations like their nutritive values, crop improvement programmes and shall also help in the identification of priority conservation areas in the region.

Keywords: Endemism, Lahaul-Spiti, Poaceae, Trans-Himalaya.

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Introduction

The Trans-Himalayan region of India constitutes a Cold Desert biome with harsh climatic conditions of piercing hot summers to long freezing winters. The soil is not very fertile and prevailing climatic conditions allow very short growing seasons making it a bare landscape with minimal water resources comprises of glacier-fed streams. The area of their occurrence is Ladakh region of Jammu and Kashmir; Lahaul and Spiti, Pooh sub division of Kinnaur and Pangi (Chamba District) of Himachal Pradesh. The study area Lahaul and Spiti district can be divided into four valleys based on intersecting river system: Chandra Valley (Chandra River), Bhaga Valley (Bhaga River), Pattan Valley (Chandrabhaga River) and Spiti Valley (Spiti River).

The fascinating flora of Lahaul- Spiti has attracted the attention of various researchers from time to time. William Moorcraft (1) made the pioneer attempt to collect plants from Lahaul -Spiti and neighboring provinces of Kangra and Kullu in 1821. G. Watt (2) and Aitchinson (3) were among the earlier plant explorers of the 19thcentury. In the 20th century notable collections were made by Joshi

(4), N.L. Bor (5), M.A. Rau (6), N.C. Nair (7), B.K. Kapahi (8), W. Koelz (9), U.C. Bhattacharya (10), Aswal and Mehrotra (11). However, from the 21st century S.K. Murti (12), K. Chandra Sekar and S.K. Srivastava (13) deserve special mention. Notable works relevant in present context pertaining to the diversity of family poaceae are "Flora of Lahaul-Spiti" and "Flora of the Pin valley National park". In Flora of Lahaul – Spiti, Aswal and Mehrotra have described 41 genera and 102 species in Lahaul-Spiti. Whereas, Chandra Sekar and Srivastava have described 30 genera and 69 species from Pin valley National park (Lahaul-Spiti).

This communication provides an updated checklist of the family *Poaceae* Barnhart, along with the localities of their occurrence, geo-referencing pertaining to the sites of collection to further understand the grass diversity and distribution in the region (Fig. 1).

Materials and Methods

Study site

The present study was conducted in the Lahaul-Spiti district of Himachal Pradesh. Lahaul-Spiti is a part of Indian cold desert in the Northwestern Himalaya. The cold deserts in Himachal Pradesh cover nearly 35 per cent of its geographical area (14). It lies between 31°44'57" and 32°59'57" N latitudes and 76°46'29" and 78°41' 34"E longitudes. Geographically it is the largest district in Himachal Pradesh and occupies an area of ca 13, 883 km^2. Two different mountainous tracts or sub divisions, one as Lahaul located in the northwestern part of the district and the other as Spiti located in southeastern part. These two subdivisions are equally differing from each other in various features. Lahaul Valley is physically more accessible as compare to Spiti. Lahaul is a valley of glaciers with higher mountain ranges and narrow river valleys (15). The Spiti Valley is located in the rain shadow zone of the Great Himalayan ranges. It is comparatively drier than Lahaul and here wind is generally weak at the lower elevations but strong at the higher reaches (16).

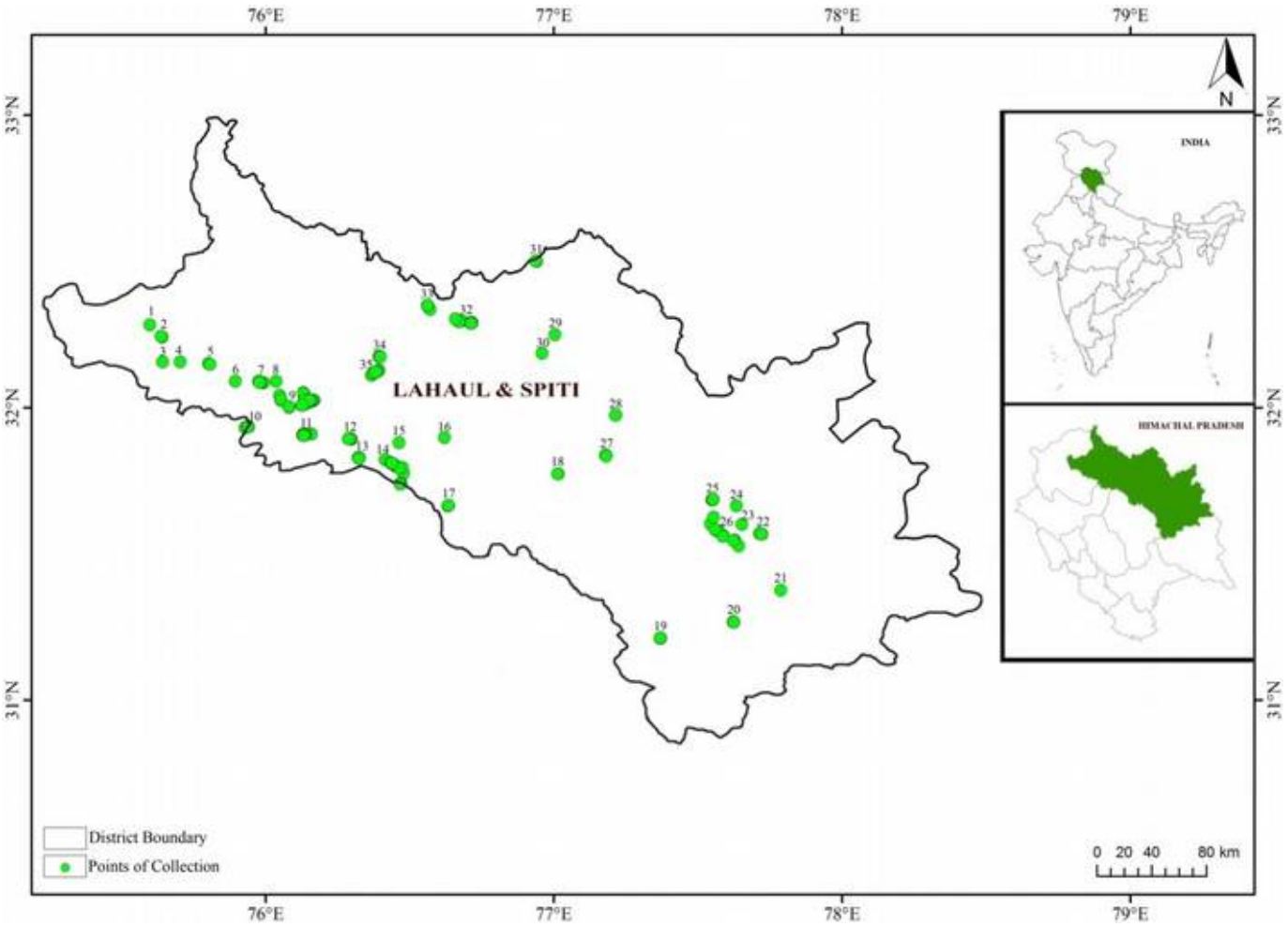

Fig 1. Map of the study area. The localities and points of collection are depicted in this map as circles and points respectively. The codes for localities are as follows: 1 Madgram 2700 m; 2 Udaipur 2800 m; 3 Trilokinath 3300 m; 4 Salpat 2700 m; 5 Kukkumseri 2700 m; 6 Jahalma 2700 m; 7 Thirot 2800 m; 8 Shansha 2900m ; 9 Keylong 3100 m; 10 Tandi 3000 m ; 11 Gondhla 4000 m; 12 Khoksar 3200 m; 13 Sissu 3100 m; 14 Way to Gramphoo 3400 m; 15 Gramphoo 3300 m; 16 Chandratal 4250 m; 17 Chhatru- Chhotadara 3450 m 18 Losar 4085 m ; 19,20, 21 Pin Valley 3845 m, 4000 m, 4050m ; 22 Koumik 4848 m , 23 Key 4166 m; 24 Langza 4400m; 25 Kibber 4270 m; 26 Morang 3890 m; 27, 28 Hamse 4450m, 4385m ; 29,30 Tokpo-yongma 4380 m, 4640 m; 31 Sarchu 4282 m; 32 Darcha 3550m; 33 Kenlung 3575m; 34 Yete 4585 m; 35 Jispa 3345 m

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Fig 2. A & B Alpine arid pastures (AAP) of Gramphu and Pattan Valley; **C &D** Alpine arid scrub (AAS) of Kunzum Pass and Pin Valley; **E & F** Marsh meadows (MM) of Salpat and Tandi; **G & H** Denuded landscape & Glacial moraine in Spiti valley.

The floristic diversity of the region is of steppe type which is rich at lower elevations but becomes poorer upwards (17) Aswal and Mehrotra (18) in their phytogeographical studies on the flora of Lahaul-Spiti, reported that the flora of the region shows more affinity with the mountain flora of the Middle Asia. Report of Eco Task Force on Grasslands and Deserts (19) categorized vegetation of the region into Alpine arid scrub (AAS), Alpine arid pastures (AAP) and Marsh meadows (MM).

Data collection

Systematic surveys were conducted in district Lahaul - Spiti to cover all the altitudinal zones including all representative vegetation types: Alpine arid scrub, Alpine arid pastures and Marsh meadows (Fig. 2). The specimens were pressed, dried, mounted and identified with the help of relevant literature/flora as (5,11,20,21) and consulting herbarium specimens at the Dehradun Herbarium (DD) and Botanical survey of India

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Herbarium (BSD). The voucher specimens were deposited to the DD herbarium, Dehradun.

The localities and the points of the collection are depicted on the classified map. The areas surveyed in the Lahaul represent an altitudinal range from 2680 m to 4025 m that includes major localities *viz*. Madgram, Udaipur, Trilokinath, Salpat, Kukkumseri, Jahalma, Thirot, Shansha, Keylong, Tandi, Gondhla, Khoksar, Sissu. In the Spiti area the localities surveyed included Gramphoo, Chandratal, Chhatru- Chhotadara, Losar, Pin Valley, Koumik, Key, Langza, Kibber, Morang, Hamse, Tokpo-yongma, Sarchu, Darcha, Kenlung, Yete, Jispa encompassing a range of altitudes from 3300 m to 4848 m.

Result and Discussion

The temperate and alpine grasslands are spread across altitudes higher than 2100 m and include the temperate and cold desert areas of Himachal Pradesh, Jammu and Kashmir and Uttarakahand states. Planning Commission Task Force on grasslands suggested that there is an urgent need to increase grasslands and desert ecosystems in Protected Area system, especially in the Thar Desert and the cold desert (19). The grass wealth of this cold region has important role in the livelihood of the people with impact on their agriculture, economy and ecology. The characteristic arid-adapted high altitude grasses forms scattered patches on vast denuded lands.

Earlier work from the study area in the field of distribution and diversity of grass flora (Poaceae) includes monumental works of Aswal and Mehrotra (11) in which they have described 41 genera and 102 species of poaceae in Lahaul-Spiti. Murti (12) while documenting flora of cold desert of Western Himalaya have described 44 genera and 134 grass species from Lahaul-Spiti region. Whereas, Chandra Sekar and Srivastava (13) have described 30 genera and 69 species of grasses from Pin valley National park (Lahaul-Spiti).

The present study documents a total of 138 species and three subspecies *viz*. *Calamagrostis pseudophragmites* subsp. *tartarica*, *Poa bactriana* subsp. *glabriflora* and *Poa pratensis* subsp. *angustifolia* of grasses belonging to 46 genera from the study area (Supplementary Table 1). Presence of 141 taxa of grass wealth in an area of ca. 13, 883 km^2 indicates rich grass floral diversity in the region.

According to Twiss (22) Taxa of the subfamily Pooideae is known to grow in the higher latitudes and elevations. In the present study, the dominant subfamily was also found to be Pooideae which constitutes 87% of the total graminoides in the region.

A total of 14 tribes are found in the study area; 12 tribes *viz*. Agrostideae, Arundineae, Aveneae, Brachypoideae, Bromeae, Chlorideae, Danthonieae, Eragrosteae, Festuceae, Meliceae, Stipeae, Triticeae belonging to sub-family Pooideae whereas, two tribes *viz*. Andropogoneae and Paniceae are from sub-family Panicoideae. Out of these 14 tribes, tribe Aveneae is the most diverse tribe with 8 genera followed by Festuceae (7), Andropogoneae (6), Agrostideae (6); Paniceae (4), Triticeae (4), Stipeae (2), Arundineae (2), Eragrosteae (2), Brachypoideae (1), Bromeae (1), Chlorideae (1), Danthonieae (1), and Meliceae (1).

The most dominant genera is *Poa* with 27 species and 3 sub-species followed by *Festuca* (10), *Stipa* (10), *Bromus* (9), *Elymus* (9), *Calamagrostis* (8 and 1 sub-species), *Agrostis* (7), *Pennisetum* (4), *Piptatherum* (3), *Brachypodium* (2), *Bothriochloa* (2), *Colpodium* (2), *Danthonia* (2), *Digitaria* (2), *Eragrostis* (2), *Eremopoa* (2), *Hordeum* (2), *Koeleria* (2), *Puccinellia* (2), *Setaria* (2), *Tripogon* (2) *Trisetum* (2). A total of 24 genera are represented with single species *viz*. *Alopecurus*, *Anthoxanthum*, *Arthraxon*, *Arundo*, *Avena*, *Briza*, *Chrysopogon*, *Cymbopogon*, *Cynodon*, *Dactylis*, *Dactyloctenium*, *Deschampsia*, *Duthiea*, *Echinochloa*, *Helictotrichon*, *Hierochloe*, *Leymus*, *Melica*, *Phaceleurus*, *Phleum*, *Phragmites*, *Polypogon*, *Saccharum* and *Secale*. Out of total 141 taxa, *Poa koelzii* and *P. Lahaulensis* are endemic to Lahaul-Spiti District.

Tufted perennial life forms are preferred over erect annuals i.e. 81 % of the total graminoides in region consisted of tufted perennial as shown in Supplementary Table 1 (114 to 141 taxa). Smaller woody plants as well as perennial herbs and grasses are ecological adaptations to survival under dry conditions, where primarily areas are exposed to drier conditions and greater evapotranspiration.

The checklist of family *Poaceae* will help in undertaking the further studies on quantitative assessments of the grass species making use of remote sensing and mapping technologies. The present study provides an updated checklist of grasses in Lahaul and Spiti district by extensive collections throughout the region, and includes the endemic and rare species. Further research should now focus on quantitative and qualitative assessment of these species like their nutritive values, crop improvement programmes and to identification of priority areas for conservation in the region.

Conclusions

Based on the present study, the Poaceae is represented by 141 taxa belonging to 14 tribes in the Lahaul-Spiti District of Himachal Pradesh, India. The maximum numbers of species (30 species) are in the genus Poa; whereas, 24 genera are mono-specific. Grasses have great significance in the livelihood of the people impacting their socio-economy but their role in stabilization of

ecologically fragile cold desert ecosystem is unparallel. Tufted perennials life forms (114 species) which during adversities reduced to root crown are preferred over erect annuals (27 species). Although most of grass species show a wide range of distribution but some species are rare in occurrence (38 species), seems due to greater tourism potential of the region which, probably have contributed in habitat loss.

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Author's contribution

RN conceived the idea. Field visit, collection and identification of specimen, manuscript writing was done by RN and SB. HBN, PKV and AC contributed in specimen identification and Manuscript corrections. RV contributed in the herbarium specimen preparation and image processing. AK helped in the GIS mapping.

Competing Interest

The authors have no conflict of interests.

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