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A conspectus of the tribe Andropogoneae of Poaceae in Western Himalaya

Shailja Tripathi, Priyanka Agnihotri[1], Rekha Yadav, Dileshwar Prasad, Shubham Jaiswal and **Tariq Husain**

Plant diversity, Systematics & Herbarium Division, CSIR-National Botanical Research Institute, Rana Pratap Marg, Lucknow - 226001, India
[1]*Corresponding author*; *e-mail*: priyagni_2006@yahoo.co.in

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Abstract

The present work is a critical assessment of published literature, herbarium records and field observations on the diversity, distribution and endemism in the tribe Andropogoneae belonging to the family Poaceae (Grasses) from Western Himalaya. A total of 33 genera with 113 species and one sub-species have been recorded from Western Himalaya. Maximum species diversity has been observed between an elevation of 1500 6 2000 m asl and the most diverse genus is *Cymbopogon* which is represented by 12 species and one sub-species. The tribe is of enormous economic potential and thereby needs documentation of its diversity and conservation status.

***Key words*:** Andropogoneae, Poaceae, diversity, distribution, endemism, Western Himalaya

INTRODUCTION

Western Himalaya refers to the western half of the Himalayan mountain region, which stretches from northeastern Afghanistan through India to central Nepal. In India, Western Himalaya spreads over three states viz. Jammu and Kashmir, Himachal Pradesh and Uttarakhand, categorized as one phytogeographic unit encompassing an area of about 3.31 lakh square km which represents ca 10% of the total geographical area of the country (Jalal & Jayanthi 2015). Western Himalaya has always been a fascinating spot for the botanists for exploration of biodiversity. Distinctive features of the Western Himalaya render it complexity attributed to both physical as well as biological diversity. The region is bestowed with significant altitudinal and temperature gradient and variable climatic conditions, manifesting biodiversity profusion over there. Presence of valleys, glaciers, continental ridges and dunes adds to the geographical beauty of the region. Western Himalaya possesses vast biodiversity which is still untapped and requires major efforts to explore the region entirely so that new insights can be inferred relevant for nature and mankind. From ancient times, different workers have been involved in the study of the diversity of various life forms present in the Western Himalayan region. In this context, plants have always been the keen centre of attraction alluring the researchers with their beauty. Most of the plants are very showy and beautiful and therefore easily get selected to work upon. Several studies have been made in such type of Himalayan plants including those of *Pedicularis* (Husain *et al*. 2010), *Aconitum* (Agnihotri *et al*. 2015), *Delphinium* (Agnihotri & Husain 2019) and orchids (Jalal & Jayanthi 2015). Grasses, on the other hand, lack the conspicuous features and therefore, have been overlooked by botanists. Despite the utmost importance of grasses to mankind, it continues to be a neglected subject (Yadav 2010).

Inconspicuous floral organs, difficult identification, the complicated structure of the spikelets and inflorescence repel the researchers to get in touch with grasses. Taxonomically, grasses are highly complex in nature and require incentives to resolve the complexity of the group. Being one of the regions of biodiversity hot spots, Western Himalaya has an abundance of floristic diversity. Grasses form an integral part of this diversity. Unfortunately, due to the above-specified reasons, grasses are always taken for granted due to which significant studies of grasses have not been undertaken yet. Keeping in mind these aspects and realizing the relevance of grass study, the present study has been designed to frame a picture of biodiversity of a particular tribe Andropogoneae which later would be complemented by the study of the whole group of grasses from the specified region.

The tribe Andropogoneae (Poaceae) nested in the subfamily Panicoideae along with Maydeae and Paniceae is characterized by the presence of fragile racemes bearing spikelets (Clayton 1981). Globally, *ca* 1000 species belonging to 85 genera of Andropogoneae (Clayton *et al*. 1986) are known to be widely distributed in the tropics and extend into warm temperates. Hartley in 1950 on the basis of his studies suggested that the Indo-Malayan region has relatively rich species diversity of the group highly concentrated in Western India and Southern Indonesia. In Indian context, the recent studies (Kiran *et al*. 2008) revealed that Peninsular India especially the region of Western Ghats is considered to be the centre of diversity of Andropogonoid grasses supported by morpho-taxonomic and phytogeographical analysis. Members of Andropogoneae bear paired spikelets with one sessile and other pedicelled, arranged in modified racemes terminating in a triad of one sessile and two pedicelled spikelets (Simon 2007). Most of the Andropogonoids possess a distinctive disarticulating rachis which is responsible for their worldwide distribution (Clayton 1987). The variations in climatic factors considerably influence the distribution of these grasses (Hartley 1950). Extreme morphological variations in the inflorescence and raceme segments of the tribe render it as one of the most complex groups of grasses. The occurrence of inter-generic hybrids has also been reported in the tribe (Pachakkil *et al*. 2018). The tribe includes several genera of ecological and economic importance distributed worldwide like *Saccharum, Sorghum, Cymbopogon, Chrysopogon*, etc. Most of the medicinally important and essential oil-bearing grasses including *Cymbopogon, Dichanthium, Saccharum, Chrysopogon* belong to the tribe Andropogoneae (Shukla 1996).

Views regarding the classification of grasses have always been of a controversial nature. Different workers opted distinct classification systems for classifying grasses. The first scientific subdivision of the family was done by Robert Brown in 1814 where he distinguished the spikelets of Pooideae and Panicoideae (Bor 1960). Demarcation in further divisions of the tribe Andropogoneae has been problematic (Vegetti 1998). Hackel in 1889 for the first time provided insights of Andropogoneae where he divided the tribe into five subtribes and 30 genera which are further categorized as series, subgenera and sections. Recent phylogenetic studies revealed the monophyletic origin of Andropogoneae (GPWG 2001). A floristic account of Indian grasses has been detailed by Hooker (1897) in his *Flora of British India*. Thereafter, an elaborated account of grasses has provided by Bor (1960). Meanwhile, various fragmentary studies on the grasses have been in prevalence. A comprehensive systematic study of grass flora from India is still lacking and this lacuna is to be filled as soon as possible.

The present article is an attempt to provide an overview of the tribe Andropogoneae which can be used as baseline data for further studies of the group. Classification of grasses provided by Bor (1960) has been used as a basis in the present study.

METHODOLOGY

For abundance and distribution related information of the taxa, published literature was surveyed followed by the field observation, consultation of some national herbaria *viz.* CAL, CDRI, CIMAP, DD & LWG and several plant database websites etc. Based on the information, the abundance was confirmed through ground-truthing conducting sporadic field survey in the Western Himalaya region. Field surveys to the specified region were done during the months of August, September and October 2018 and extensive collections were made from Manali, Rohtang Pass, Solang valley, Naggar region of Himachal Pradesh, Pauri Garhwal, Auli, Joshimath, Srinagar and Nainital of Uttarakhand. Thereafter, identification of the specimens was done using literature from different sources. The keys of identification provided by Bor (1960), Sreekumar (1991), Shukla (1996), Potdar *et al*. (2012) have been used. Moreover, the herbaria specimens have also been consulted in order to make the identification more authenticated.

RESULTS AND DISCUSSION

In Western Himalaya, Poaceae is represented by 33 genera with 113 species and one subspecies (Table 1) which presents 52% of the total genera and 32% of the total species of Andropogoneae found in India and 39% of the total genera and 11% of the species found in the world (Table 2). Our data analysis displays that Uttarakhand has the maximum diversity of the Andropogonoids followed by Himachal Pradesh and Jammu and Kashmir (Figure 1) 44 taxa of Andropogonoids are found to occur exclusively in Uttarakhand as compared to seven in Himachal Pradesh and none in Jammu and Kashmir. As a whole, the region is found to have 30 taxa in common among the three states. The diversity in Uttarakhand may be attributed to its topographical and climatic factors which provide suitable environmental conditions for the luxurious growth of these grasses. But it is worthy to note that diversity of Andropogonoids is found to be more in Peninsular India as compared to the Western Himalaya. This difference in diversity may be attributed to the climatic variations existing between the two regions.

Table 1. Distribution of different taxa of Andropogoneae in Western Himalaya [*Abbreviations used:* HP = Himachal Pradesh; J&K = Jammu & Kashmir; UK = Uttarakhand]

S. No.	Name of taxa	Flowers & Fruits	Altitude (m)	Distribution	
				Western Himalaya	World
01	*Andropogon munroi* C.B. Clarke	Jul.–Sept.	1500–3500	HP, UK	China, Nepal
02	*Andropogon pumilus* Roxb.	Aug.–Oct.	5000	UK	Indo-China
03	*Apluda mutica* L.	May.–Feb.	1000–2400	HP, J&K, UK	Bhutan, China, Japan, Madagascar, South East Asia
04	*Apocopis paleacea* (Trin.) Hochr.	Jul.– Nov.	900–1200	UK	Bhutan, Malaysia, Thailand

S. No.	Name of taxa	Flowers & Fruits	Altitude (m)	Distribution	
				Western Himalaya	World
05	*Apocopis vaginata* Hack.	Sept.–Dec.	300–1200	UK	-
06	*Arthraxon nudus* (Steud.) Hochst.	Aug.–Feb.	1200–1300	UK	Myanmar, China, Thailand
07	*Arthraxon hispidus* (Thunb.) Makino	Sept.–Oct.	1700	HP, UK	Bhutan, China
08	*Arthraxon lanceolatus* (Roxb.) Hochst.	Aug.– Jan.	2400	HP, UK	Arabia, Nepal, China
09	*Arthraxon lancifolius* (Trin.) Hochst.	Jul.–Oct.	1500–2000	HP, J&K, UK	Africa, Bhutan, Myanmar, Sri Lanka, China, Pakistan, Malaysia
10	*Arthraxon microphyllus* (Trin.) Hochst.	Sept.	1200–1500	HP	Bhutan, Nepal
11	*Arthraxon prionodes* (Steud.) Dandy	May.– Aug.	600–3600	HP, J&K	Africa, Bhutan
12	*Arthraxon santapaui* Bor	Aug.– Sept.	1600	UK	-
13	*Arthraxon submuticus* (Nees ex Steud.) Hochst.	Sept.–Oct.	600–1800	HP	China
14	*Bothriochloa bladhii* (Retz.) S.T. Blake	Apr.–Jun.	950	HP, J&K, UK	Africa, Australia, Bhutan, China, Pakistan
15	*Bothriochloa insculpta* (A.Rich.) A. Camus	Sept.– Jan.	1500	UK	Australasia, Europe
16	*Bothriochloa ischaemum* (L.) Keng	Jul.–Oct.	3600	HP, UK	Africa, Bhutan, Europe, Nepal, Pakistan
17	*Bothriochloa kuntzeana* (Hack.) Henrard	Sept.– Dec.	1500	UK	Nepal
18	*Bothriochloa pertusa* (L.) A. Camus	Jul.–Oct.	1500–3500	HP, J&K, UK	Afghanistan, Africa, Sri Lanka, China, Pakistan
19	*Capillipedium assimile* (Steud.) A. Camus	Sept.–Jan.	1400	HP, UK	Australia, Bhutan, Pakistan, South Africa
20	*Capillipedium huegelii* (Hack.) A.Camus	Aug.– Sept.	1350	UK	Africa, Asia, Myanmar
21	*Capillipedium parviflorum* (R.Br.) Stapf	Jul.–Sept.	1700	HP, J&K, UK	Australia, Bhutan
22	*Chrysopogon nodulibarbis* (Hochst. ex Steud.) Henrard	Dec.– Feb.	1000–1200	UK	Pakistan, Sri Lanka

S. No.	Name of taxa	Flowers & Fruits	Altitude (m)	Distribution	
				Western Himalaya	World
23	*Chrysopogon aciculatus* (Retz.) Trin.	Aug.–Sept.	1000	UK	Bhutan, Myanmar, Sri Lanka
24	*Chrysopogon fulvus* (Spreng.) Chiov.	Feb.–May., Jul.–Sept.	1000–2000	HP, J&K, UK	East Africa
25	*Chrysopogon gryllus* (L.) Trin.	Jul.–Oct.	1500–3500	HP, J&K, UK	Bhutan, Nepal
26	*Chrysopogon serrulatus* Trin.	Jun.–Dec.	0–1000	HP, UK	Bhutan, Nepal, Pakistan
27	*Chrysopogon zizanioides* (L.) Roberty	Jul.–Nov.	1000	HP, J&K,UK	Africa, Bhutan, Myanmar, South East Asia, Sri Lanka
28	*Cymbopogon caesius* (Hook. & Arn.) Stapf	Aug.–Sept.	2600	UK	Pakistan
29	*Cymbopogon commutatus* (Steud.) Stapf	Apr.–Oct.	1500	HP	Arabia, Africa, South Asia
30	*Cymbopogon distans* (Nees ex Steud.) W. Watson	Jun.–Oct.	1500–3000	HP, UK	China
31	*Cymbopogon flexuosus* (Nees ex Steud.) W.Watson	Sept.–Oct.	100–2200	UK	Myanmar, Thailand
32	*Cymbopogon gidarba* (Buch.- Ham. ex Steud.) A. Camus	Aug.–Sept.	1800	HP, UK	Myanmar
33	*Cymbopogon jwaranscusa* (Jones) Schult.	Mar.–May.	3000	HP, J&K, UK	Africa, Bhutan, Nepal, Sri Lanka
34	*Cymbopogon jwarancusa* subsp. olivieri (Boiss.) Soenarko	Jul.–Sept.	0–3000	HP	Pakistan
35	*Cymbopogon martini* (Roxb.) W.Watson	Aug.–Nov., Feb.–May.	1400–1500	HP, J&K, UK	Bhutan
36	*Cymbopogon microstachys* (Hook.f.) Soenarko	Jul.– Sept.	1200	UK	China
37	*Cymbopogon nardus* (L.) Rendle	Nov.–Apr.	1500	HP, UK	Bhutan, China
38	*Cymbopogon osmastonii* R. Parker	Nov.–Apr.	480–3200	UK	Bangladesh
39	*Cymbopogon pospischilii* (K. Schum.) C.E. Hubb.	Sept.–Nov., Mar.–Apr.	1400	HP, UK	China, Pakistan

S. No.	Name of taxa	Flowers & Fruits	Altitude (m)	Distribution	
				Western Himalaya	World
40	*Cymbopogon schoenanthus* (L.) Spreng.	Mar.–Jun.	1500	HP	-
41	*Dichanthium annulatum* (Forssk.) Stapf	Feb.–Dec.	1000–1800	HP, J&K, UK	Africa, Australia, Bhutan, China, Myanmar, Indonesia
42	*Dichanthium foulkesii* (Hook.f.) S.K. Jain & Deshp.	Sept.–Oct.	2000	UK	Africa, China
43	Dichanthium foveolatum (Delile) Roberty	Aug.–Nov.	1800	HP, J&K	Ethiopia, Iran, Sri Lanka, Tanzania
44	*Dimeria ornithopoda* Trin.	Sept.–Nov.	460–600	UK	Australia, Japan, Malaya, Myanmar, Nepal
45	*Eulalia contorta* (Brongn.) Kuntze	Sept.–Oct.	1800	UK	Australia, Bhutan, China, Malaysia
46	*Eulalia fimbriata* (Hack.) Kuntze	Oct.– Feb.	300–1200	HP	Myanmar
47	*Eulalia hirtifolia* (Hack.) A. Camus	Aug.–Oct.	1500–3500	HP, UK	-
48	*Eulalia leschenaultiana* (Decne.) Ohwi	Dec.–Feb.	1600–2400	UK	Bhutan, China, Philippines, Thailand
49	*Eulalia madkotiensis* Kandwal, B.K. Gupta & S.K. Srivast.	Aug.–Sept.	1500	UK	-
50	*Eulalia mollis* (Griseb.) Kuntze	Aug.–Oct.	1500–3500	HP, UK	Bhutan, China, Nepal, Pakistan
51	*Eulalia quadrinervis* (Hack.) Kuntze	Sept.–Oct.	2600	HP,UK	Bhutan, Myanmar, Nepal, China, Thailand
52	*Eulalia staintonii* Bor	Aug.–Sept.	1500–2600	UK	Nepal
53	*Eulalia trispicata* (Schult.) Henrard	Sept.–Nov.	300–1500	HP, UK	Bangladesh, Bhutan, Myanmar, China, Malaysia, Nepal, Sri Lanka, Vietnam
54	*Eulaliopsis binata* (Retz.) C.E. Hubb.	May.–Nov.	2200	HP, J&K, UK	Afghanistan, Bhutan, China, Myanmar, Philippines, Thailand
55	*Hackelochloa granularis* (L.) Kuntze	Jul.–Nov.	1500	HP, J&K, UK	Africa, Bhutan, Myanmar, Sri Lanka
56	*Hemarthria altissima* (Poir.) Stapf & C.E. Hubb.	Nov.–Feb.	500	UK	China
57	*Hemarthria compressa* (L.f.) R.Br.	Aug.–Sept.	1500	HP, J&K, UK	Bhutan

S. No.	Name of taxa	Flowers & Fruits	Altitude (m)	Distribution	
				Western Himalaya	World
58	*Heteropogon contortus* (L.)P. Beauv. ex Roem. & Schult.	Jun.–Dec.	1800–3000	HP, J&K, UK	Bhutan
59	*Heteropogon melanocarpus* (Elliott) Benth.	Aug.–Sept.	1000–1500	UK	China
60	*Imperata cylindrica* (L.) Raeusch.	Jan.–Dec.	1200–2500	HP, J&K, UK	Myanmar, Sri Lanka
61	*Ischaemum polystachyum* J. Presl	Aug.–Jan.	50–700	HP	Bangladesh
62	*Ischaemum rugosum* Salisb.	Aug.–Oct.	1400	HP, J&K, UK	Africa, Bhutan, China, Malaya, Myanmar, Sri Lanka, Thailand, China
63	*Iseilema anthephoroides* Hack.	Aug.–Dec.	400–425	UK	-
64	*Iseilema laxum* Hack.	Aug.–Dec.	1100–2750	UK	Sri Lanka
65	*Microstegium ciliatum* (Trin.) A. Camus	Aug.–Nov.	600–1500	HP, J&K, UK	Bhutan, Myanmar
66	*Microstegium delicatulum* (Hook.f.) A.Camus	Sept.–Oct.	800–1600	UK	Myanmar, China, Thailand
67	*Microstegium eucnemis* (Nees ex Steud.) A. Camus	Dec.–Jan.	990–2300	UK	Myanmar, China, Thailand
68	*Microstegium falconeri* (Hook.f.) Clayton	Sept.–Nov.	1700–2500	HP, UK	Bhutan
69	*Microstegium fasciculatum* (L.) Henrard	Sept.–Nov.	1400	UK	Bhutan, Myanmar, China, Nepal, Thailand, Veitnam
70	*Microstegium nudum* (Trin.) A. Camus	Jun.– Jul., Sept.–Nov.	1800–3600	HP, UK	Bhutan, Nepal
71	*Microstegium petiolare* (Trin.) Bor	Sept.–Dec.	1500–2400	HP, UK	Myanmar, Nepal
72	*Microstegium vimineum* (Trin.) A. Camus	Dec.	1200–1500	HP, UK	Bhutan, China, Japan, South East Asia
73	*Miscanthus fuscus* (Roxb.) Benth.	Apr.–Jun.	2500	UK	-
74	*Miscanthus nepalensis* (Trin.) Hack.	May–Jun., Sept.–Oct.	1500–3000	HP, UK	Myanmar, Nepal
75	*Mnesithea laevis* (Retz.) Kunth	Sept.–Oct.	500	HP, J&K, UK	Bhutan, Indo- China, Malay Islands, Myanmar, Sri-Lanka

S. No.	Name of taxa	Flowers & Fruits	Altitude (m)	Distribution	
				Western Himalaya	World
76	*Ophiuros exaltatus* (L.) Kuntze	Jul.– Feb.	600–1000	UK	China
77	*Phacelurus speciosus* (Steud.) C.E. Hubb.	Jul.–Sept.	1600–3500	HP, J&K, UK	-
78	*Pogonatherum crinitum* (Thunb.) Kunth	Sept.–Oct.	750	HP, UK	Afghanistan, Myanmar, China, Malaya
79	*Pogonatherum paniceum* (Lam.) Hack.	Apr.–Nov.	600–800	HP, J&K, UK	Myanmar, Sri-Lanka
80	*Pogonatherum santapaui* Sur	May–Oct., Dec.–Mar.	770–1400	UK	-
81	*Polytrias indica* (Houtt.) Veldkamp	Aug.– Nov.	2100–2400	UK	Bangladesh, China, Myanmar, Sri Lanka, Vietnam
82	*Pseudosorghum fasciculare* (Roxb.) A. Camus	Sept.– Dec.	1500–2300	UK	Bhutan, Myanmar, South East Asia
83	*Rottboellia cochinchinensis* (Lour.) Clayton	Aug.– Nov.	1500	UK	Africa, Australia, China, Malaya, Sri Lanka
84	*Rottboellia exaltata* (L.) L.f.	Aug.– Nov.	600	HP, J&K, UK	China, Pakistan
85	*Saccharum arundinaceum* Retz.	Aug.–Apr.	1000	UK	Bangladesh, Bhutan, Myanmar, Sri Lanka
86	*Saccharum bengalense* Retz.	Sept.– Dec.	1700	HP, J&K, UK	-
87	*Saccharum filifolium* Steud.	Apr.–Oct.	1500–2500	HP, UK	-
88	*Saccharum griffithii* Munro ex Aitch.	Jul.–Oct.	-	UK	Afghanistan, Pakistan
89	*Saccharum longisetosum* (Andersson) V.Naray. ex Bor	Sept.– May.	1500–3000	HP, UK	Myanmar, Nepal, Bangladesh
90	*Saccharum narenga* (Nees ex Steud.) Hack.	Aug.– Nov.	800	UK	Myanmar, Bhutan
91	*Saccharum officinarum* L.	Jan.–Feb.	1000	UK	Africa
92	*Saccharum ravennae* (L.) L.	Sept.– Nov.	1800–2700	HP, J&K, UK	Pakistan
93	*Saccharum rufipilum* Steud.	Jun.–Dec.	800–2100	HP, J&K, UK	Myanmar
94	*Saccharum spontaneum* L.	Aug.–Jan.	1000–1500	HP, J&K, UK	Africa, Australia, Myanmar, South Europe, Sri Lanka

S. No.	Name of taxa	Flowers & Fruits	Altitude (m)	Distribution	
				Western Himalaya	World
95	*Schizachyrium brevifolium* (Sw.) Buse	Sept.–Dec.	1500	UK	Africa, Bhutan, Nepal, Sri Lanka
96	*Schizachyrium impressum* (Hack.) A. Camus	Aug.–Sept.	1200	J&K, UK	Pakistan
97	*Schizachyrium exile* (Hochst.) Pilg.	Sept.–Dec.	200–1500	UK	Ethiopia, South Africa
98	*Sehima nervosum* (Rottler) Stapf	Jul.–Oct.	>200	UK	Australia, Myanmar, China, Pakistan, Sri lanka, Thailand
99	*Sehima notatum* (Hack.) A. Camus	Aug.–Dec.	2300	HP, UK	-
100	*Sorghum arundinaceum* (Desv.) Stapf	Sept.–Dec.	400–3000	J&K, UK	Australia, Bhutan, Bolivia, Brazil, Pakistan, South Africa
101	*Sorghum bicolor* (L.) Moench	Sept.–Nov.	1200–1600	HP, UK	Australia, Bhutan, China, South America, Taiwan
102	*Sorghum halepense* (L.) Pers.	Mar.–Dec.	1700–1900	HP, J&K, UK	Bangladesh, Sri Lanka
103	*Sorghum miliaceum* (Roxb.) Snowden	Aug.–Nov.	750	HP, UK	Pakistan
104	*Sorghum nitidum* (Vahl) Pers.	Aug.–Dec.	500	HP, UK	Australia, Bhutan, Indo- China, Thailand
105	*Spodiopogon cotulifer* (Thunb.) Hack.	Sept.–Nov.	1600–2000	HP, J&K, UK	China, Japan
106	*Spodiopogon dubius* Hack.	Jul.–Aug.	2500–3000	HP, UK	China, Nepal
107	*Themeda anathera* (Nees ex Steud.) Hack.	Jul.–Dec.	1500–3500	HP, J&K, UK	China, Pakistan, Sri Lanka
108	*Themeda arundinacea* (Roxb.) A. Camus	Sept.–Nov.	750	HP, UK	Bhutan, Myanmar, South East Asia
109	*Themeda caudata* (nees ex Hook. & Arn.) A.Camus	Sept.–May	2000	UK	Bhutan, Myanmar
110	*Themeda gigantea* (Cav.) Hack. ex Duthie	Sept.–Apr.	700–2000	UK	Bangladesh, China, Nepal, Thailand
111	*Themeda strigosa* (Ham. ex Hook.f.) A. Camus	Nov.–Jan.	2300	UK	Bangladesh
112	*Themeda quadrivalvis* (L.) kuntze	Aug.–Nov.	2300	UK	Bhutan
113	*Themeda triandra* Forssk.	May–Oct.	1500–3500	HP, J&K, UK	Bhutan, Myanmar, Sri Lanka
114	*Themeda villosa* (Lam.) A. Camus	Aug.–Nov.	1400	HP, UK	Bhutan

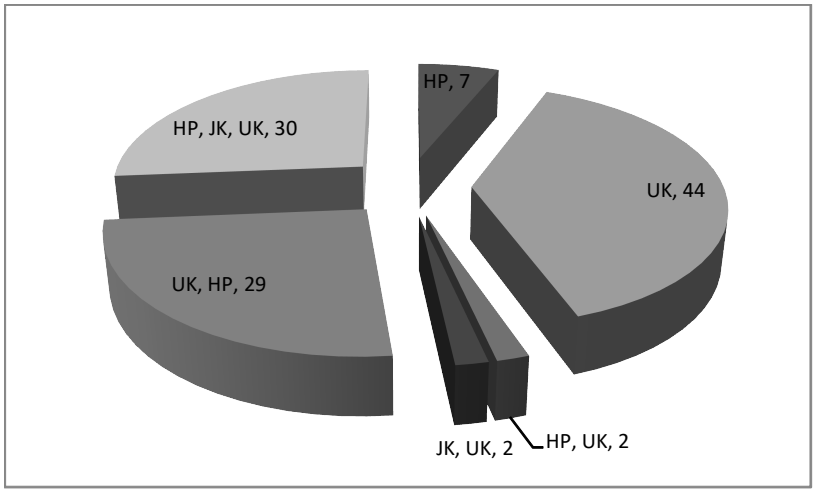

Figure 1. Distribution of taxa of Andropogoneae in different states of Western Himalaya

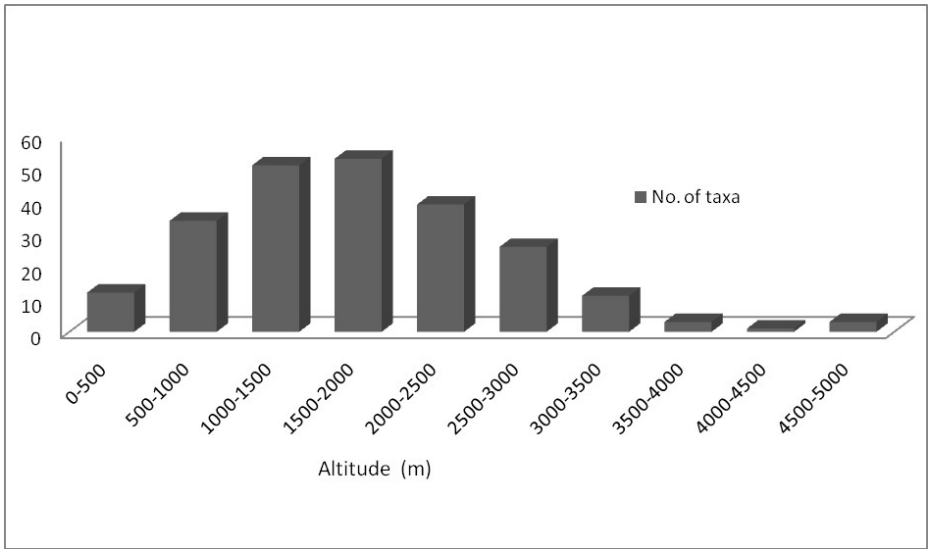

Figure 2. Altitudinal distribution of the tribe Andropogoneae in Western Himalaya

The distribution of the tribe in relation to altitude is depicted in Figure 2. Altitudinal gradient marks significant influence on diversity and distribution pattern of these grasses. Maximum diversity is found between an elevational range of 1500 – 2000 m. Many taxa like *Bothriochloa pertusa, Chrysopogon gryllus, Cymbopogon osmastonii, Eulalia mollis, Eulalia hirtifolia, Microstegium nudum, Themeda anathera, Themeda triandra,* etc show a wide range of altitudinal distribution. On the other hand, few taxa like *Arthraxon hispidus, Arthraxon lanceolatus,* etc. are found in specific range which narrow down their altitudinal distribution. Very few taxa are found at an elevation of above 3500m. There have been reports suggesting that species richness is affected by increasing altitude as there has been reduction in diversity with increased elevation. This reduction could be attributed to eco-physiological constraints such as low temperature and other geographical barriers (Agnihotri *et al*. 2015).

Table 2. Relative abundance of Andropogonoids

Region	Genera	Species	References
World	85	1000	Clayton *et al*., 1986
India	63	350	Karthikeyan *et al*., 1989
Western Himalaya	33	113	Present study

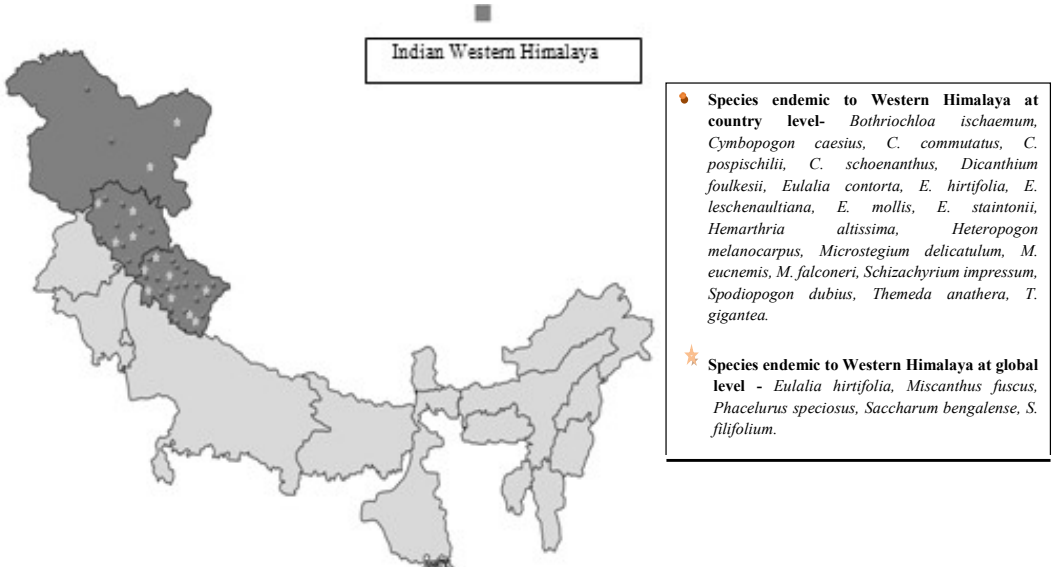

Figure 3. Distribution of endemic taxa of Andropogoneae in Western Himalaya

Out of the total taxa of Andropogonoid grasses, 46% is found to be strictly endemic to India especially to the Peninsular region (Mehrotra & Jain 1980). Present study reveals that of all the taxa found in Western Himalaya, 7 taxa (6.14%) are found to be endemic at global level (Figure 3) and 26 taxa (22.80%) at Indian level. Interestingly, 19 taxa are such which are only found in western Himalaya and nowhere else in the country but are reported from other regions of the world as in China, Nepal, Pakistan, etc signifying their occurrence in the Himalayan region. Moreover, ten monotypic genera are found to occur in the region of Western Himalaya. Seven taxa of the tribe including *Dimeria ornithopoda*, *Eulalia contorta, Hemarthria altissima*, *Hemarthria compressa*, *Imperata cylindrica*, *Pogonatherum paniceum* and *Schizachyrium brevifolium* are included in IUCN red list of threatened plants which urges an immediate conservation implication.

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