QUANTITATIVE DESCRIPTION OF UNDERSTOREY VEGETATION OF SHOGRAN VALLEY, PAKISTAN

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Abstract

Quantitative analysis of understorey vegetation was carried out at twenty two different sites of Shogran valley at the elevation range between 2357 to 2784m. Circular plots of 2.5m were used for the purpose of sampling. The present study revealed that the most common understorey species of Shogran valley were *Fragaria indica, Galium aparine, Galium boreata, Geranium wallichianum, Gentiana argenta, Micromeria biflora, Poa supina, Plantago lanceolata, Ranunculus puchellus, Rumex dentatus, Taraxacum officinale, Trifolium minus, Trifolium repens, Viburnum mullaha, Viola biflora, Anemone rivilaris, Arabidopsis thaliana, Indigofera pulchella, Rumex nepalensis* and *Trifolium minus.* These species were frequently present at the higher elevation and not found at the low elevation. *Galium boreata*, *Ranunculus pulchellus* and *Ranunculus sceleratus* were found at both the elevations. Ranunculaceae was the most common family while Fabaceae, Pinaceae, Labiatae, Primulaceae, Rosaceae and Berberidaceae were the common in this area.

Introduction

Shogran valley is located in the Northern Himalayan range and considered in the category of moist temperate deciduous forests. The total area of valley is about 35000 hectare. The whole ecosystem is confronted with biotic pressure but some of the forests are in protected zone, safe from heavy degradation and dominant seed origin for areas that are now deficient of considerable vegetation (Sher *et al.,* 2012). The valley has moist and dry temperate coniferous types of vegetation, open scrub, sub-alpine and alpine forests are the main types of vegetation (Champion *et al.,* 1965). According to Bartels and Chen (2013) canopy composition had positive effects on shrub and herb layer cover and herb layer richness, and negative effects on bryophyte and lichen species cover and richness. Shrub layer cover had no effect on herb layer cover, but shrub layer richness had a positive effect on herb layer richness.

Ummara *et al*, (2013) have presented ethnobotanical importance of fifty indigenous species of Shogran valley. Dominant species were *Taxus fuana, Pinus wallichiana, Abies pindrow and Berberis ceratophylla*. Herbs and shrubs are present with a height of 5m. Some grasses and ferns are also present. The soil is greyish brown in colour, fertile and rich in organic matter. Phytosociological studies were carried out at different areas of Pakistan by different workers *i.e.* Bokhari *et al.*, (2013), Hussain and Malik (2012), Muhammad *et al.,* (2012), Sultana *et al.* (2011), Siddiqui *et al.* (2010a), Ahmed *et al.* (2010), Malik *et al.* (2007) *etc*. Khan *et al.* (2011) studied the quantitative analysis of floristic diversity along with environmental gradient for the identification of major plant communities of Naran Valley. Mashwani *et al.* (2011) studied the vegetation diversity of alpine forest of Lake Saif-ul- Mulook located in Western Himalayan range of Pakistan. Siddiqui *et al.* (2013) studied the community arrangements, organization and changes of conifer forests of moist temperate area of Himalayan range of Pakistan, including Shogran valley. Raja *et al*. (2014) focused on the floristic composition in wet temperate forests of Pakistan. They detected the relationship between altitude and some environmental factors with the composition and structure of plants communities.

In early ecological work that conducted in mountainous areas of Pakistan usually lack of the quantitative information available about understorey species. The researcher usually emphasize only on tree species but recently Ahmed *et al.* (2006) describe the understorey vegetation along with tree species from different climatic zones of Pakistan then different workers follow this trend because ground flora is very much important to identify the seedling dynamics and floristic composition of whole forest including climate of the area. Siddiqui *et al*. (2009; 2010b; 2011 and 2013) describe the understorey vegetation with reference to different environmental aspects. Khan (2011) and Wahab (2011) described the ground flora of Chitral and Dir respectively while Akber (2013) and Hussain (2013) describe the same from different mountainous areas of Gilgit-Baltistan province. Bokhari (2013) described the ground flora of Azad Jammu and Kashmir.

Shah *et al*. (2014) carried out a phytosociological study of the vegetation of Farash hills Katlang, District Mardan, Pakistan. However no quantitative information was available about understorey vegetation of Shogran valley. Investigation of understorey vegetation is important to determine the seed/seedling dynamics of canopy tree species. Therefore, the present investigation was designed to explore the understorey vegetation of different forests of Shogran valley, Pakistan that would be helpful for forest management and conservation.

Materials and Methods

The under storey vegetation was sampled by using a circular plot of 2.5m radius at 20 point in a stand, following Ahmed and Shaukat (2012). Relative frequencies were estimated as described by Mueller-Dombois and Ellenberg (1974). The understorey vegetation of the valley was studied on the basis of relative frequency.

Results and Discussion

According to Warnock *et al.*, (2007) tree crown cover or canopies usually alter the composition of understorey species. Canopy species can directly facilitate understorey species through altering soil bulk density, precipitation distribution under their sub canopy, soil surface temperature, available sun light, soil moisture, soil oxygen, soil and leaf litter accumulation, seed bank density and soil nutrient concentration. Increasing canopy broad-leaf composition, through its influence on soil nutrients, promotes shrub and herb layer species, but limits bryophyte and lichen species. According to Bartels and Chen (2013) the canopy trees controlled understorey resource environment, cover and richness of shrub and herb layers increase with resource availability. Bearing these points in mind the present study conducted to investigate the understorey species of Shogran valley.

The present study of understorey vegetation was conducted at two main locations of Shogran valley at three different elevations. Stands 1 to 6 studied at the elevation of 2357m while stand 7 to 13 were located at 2405m elevation of Magri. Stands 14 to 22 were located at the elevation of 2784m in Sri area. Main location, site name, latitude, longitude, elevation and aspect were recorded (Table 1). Fifty four understorey species were organized alphabetically and their family, frequency and relative frequency are shown in Table 2. Percentage wise analysis of plant species per stand showed in Fig. 2 which clearly indicated the maximum frequency (%) of family in twenty two stands.

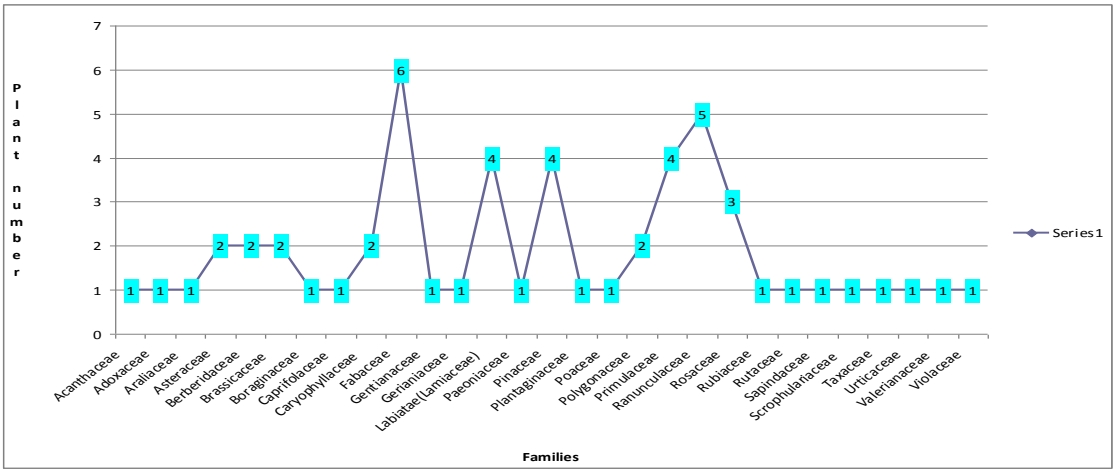

Fig. 1. Family detail with understorey species composition in study area

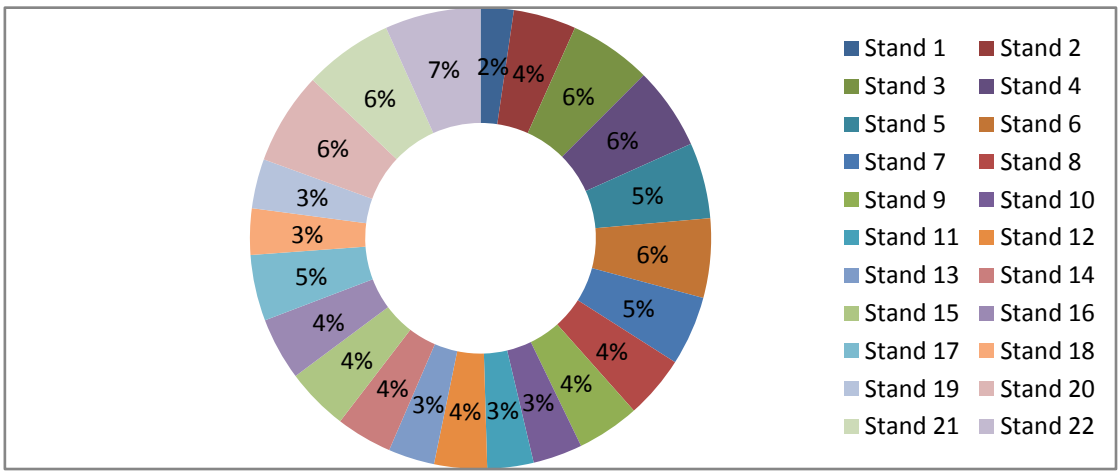

Fig. 2. Percentage of understorey species per stand

Family wise species dominance analysis revealed that Ranunculaceae is dominant family with 5 species, Fabaceae, Pinaceae and Labiatae with 4 species each, Primulaceae and Rosaceae with 3 species each, Asteraceae, Berberidaceae, Brassicaceae, Caryophyllaceae, Leguminosae, Polygonaceae and Rubiaceae with 2 species each families i.e. Acanthaceae, Adoxaceae, Araliaceae, Boraginaceae, Caprifoliaceae, Gentianaceae, Geraniaceae, Paeoniaceae, Plantaginaceae, Poaceae, Rutaceae, Sapindaceae, Scrophulariaceae, Taxaceae, Urticaceae, Valerianaceae and Violaceae showed single species in each family (Fig. 1).

The topographic positions of the stands 1 to 6 were low elevation, having under canopy and open canopy vegetation. Understorey vegetation of these stands includes sixteen species. *Viola biflora* has maximum relative frequency of 70%. *Poa supina* and *Viburnum mullaha* were occur in the stands with frequency of 65%. *Rumex dentatus* and *Trifolium repens* have 60% frequency. *Fragaria indica* was found with the frequency of 55% while frequency of 40% was shown by *Stellaria media* and *Galium aparine*. *Galium boreata* was found with the frequency of 30%. *Androsace rotundifolia*, *Plantago lanceolata*, *Ajuga parviflora, Galium boreata* and *Indigofera gerardiana* were present with the frequency of 25%. In this stand the lowest frequency (10%) showed by *Geranium wallichianum, Pinus wallichiana* (seedling), *Ranunculus pulchellus, Taxus fuana* (Seedling) and *Urtica dioica*. Some of the species were also investigated by Siddiqui (2011) and Ahmed *et al.* (2010) during the study of different moist temperate areas of Pakistan and community description of deodar forest from Himalayan range of Pakistan respectively.

Table 1. Dominant understorey species and site characteristics of twenty two stands of Shogran Valley, Pakistan

Stand Nos.	Site	Dominant understorey species	Latitude (N)	Longitude (E)	Elevation (m)	Aspect
1	Magri	*Rumex dentatus*	34º38º389´	73º28º951´	2357	NE
2	Magri	*Viola biflora*	34º38º389´	73º28º951´	2357	NE
3	Magri	*Viburnum mullaha*	34º38º389´	73º28º951´	2357	NE
4	Magri	*Viburnum mullaha*	34º38º389´	73º28º951´	2357	NE
5	Magri	*Viola biflora*	34º38º389´	73º28º951´	2357	NE
6	Magri	*Rumex dentatus*	34º38º389´	73º28º951´	2357	NE
7	Magri	*Viburnum mullaha*	34º38º349´	73º28º478´	2405	NE
8	Magri	*Fragaria indica*	34º38º349´	73º28º478´	2405	NE
9	Magri	*Poa supine*	34º38º349´	73º28º478´	2405	NE
10	Magri	*Galium aparine*	34º38º349´	73º28º478´	2405	NE
11	Magri	*Fragaria indica*	34º38º349´	73º28º478´	2405	NE
12	Magri	*Trifolium repens*	34º38º349´	73º28º478´	2405	NE
13	Magri	*Viburnum mullaha*	34º38º349´	73º28º478´	2405	NE
14	Sri	*Viburnum mullaha*	34º37º733´	73º29º282´	2784	NE
15	Sri	*Galium boreata*	34º37º733´	73º29º282´	2784	NE
16	Sri	*Poa supine*	34º37º733´	73º29º282´	2784	NE
17	Sri	*Trifolium minus*	34º37º733´	73º29º282´	2784	NE
18	Sri	*Poa supine*	34º37º733´	73º29º282´	2784	NE
19	Sri	*Geranium wallichianum*	34º37º733´	73º29º282´	2784	NE
20	Sri	*G. wallichianum*	34º37º733´	73º29º282´	2784	NE
21	Sri	*Poa supine*	34º37º733´	73º29º282´	2784	NE
22	Sri	*Trifolium minus*	34º37º733´	73º29º282´	2784	NE

Table 2. List of understorey vegetation present in twenty two stands at different sites of Shogran forests

S.No.	Species Name	Family Name	Frequency	Relative Frequency
1	*Anemone rivilaris* Buch.-Ham. ex DC.	Ranunculaceae	27	1.48
2	*Caltha palustris* Linn.	Ranunculaceae	27	1.48
3	*Ranunculus pulchellus* L.	Ranunculaceae	27	1.48
4	*Ranunculus sceleratus* L.	Ranunculaceae	27	1.48
5	*Thalictrum alpinum* L.	Ranunculaceae	27	1.48
6	*Robinia pseudoacacia* L.	Fabaceae	27	1.48
7	*Trifolium minus* (W.D.J. Koch) Kozuharov	Fabaceae	36	1.97
8	*Trifolium repens* L.	Fabaceae	40	2.19
9	*Trgonella foenum-graecum* L.	Fabaceae	27	1.48
10	*Abies pindrow* (seedlings) Royle	Pinaceae	40	2.91
11	*Cedrus deodara* (seedlings) (Roxb. ex Lamb) G. Don.	Pinaceae	27	1.48
12	*Picea smithiana* (seedlings) (Wall.) Boiss.	Pinaceae	27	1.48
13	*Pinus wallichiana* (seedlings) A.B. Jackson	Pinaceae	27	1.48
14	*Ajuga parviflora* Bth.	Labiatae/Lamiaceae	27	1.48
15	*Calamintha nepata* (L.) Savi	Labiatae/Lamiaceae	27	1.48
16	*Mentha longifolia* (L.) Huds.	Labiatae/Lamiaceae	31	1.70
17	*Micrimeria biflora* (Buch. Ham. ex D. Don) Benth.	Labiatae/Lamiaceae	40	2.91
18	*Anagallis arvensis* L.	Primulaceae	27	1.48
19	*Androsace rotundifolia* Hardw.	Primulaceae	31	1.70
20	*Primula denticulata* Sm	Primulaceae	36	1.97
21	*Fragaria indica* Andr.	Rosaceae	95	5.22
22	*Potentilla nepalensis* Hook	Rosaceae	27	1.48
23	*Rosa macrophylla* Lindl	Rosaceae	27	1.48
24	*Achillea millefolium* L.	Asteraceae	27	1.48
25	*Taraxacum officinale* F.H. Wigg.	Asteraceae	45	2.47
26	*Berberis ceratophylla* G. Don.	Berberidaceae	27	1.48
27	*Podophyllum emodi* Royle	Berberidaceae	27	1.48
28	*Arabidopsis thaliana*	Brassicaceae	31	1.70
29	*Lepidium sativum* L.	Brassicaceae	27	1.48
30	*Stellaria media* (L.) Vill.	Caryophyllaceae	31	1.70
31	*Stellaria palustris* (Murray) Retz.	Caryophyllaceae	27	1.48
32	*Indigofera gerardiana* Wall. ex Brandis.	Leguminosae	31	1.70
33	*Indigofera pulchella* Roxb.	Leguminosae	27	1.48
34	*Rumex dentatus* L.	Polygonaceae	40	2.91
35	*Rumex nepalensis* Spreng.	Polygonaceae	31	1.70
36	*Galium aparine* L.	Rubiaceae	54	2.96
37	*Galium boreata* L.	Rubiaceae	31	1.70
38	*Dicliptera roxburghiana* Nees	Acanthaceae	27	1.48
39	*Viburnum mullaha* Buch.-Ham. ex D. Don	Adoxaceae	90	4.94
40	*Hedera nepalensis* K.Koch	Araliaceae	31	1.70
41	*Myosotis alpestris* F.W.Schmidt.	Boraginaceae	27	1.48
42	*Valeriana himalayana* Grub	Caprifoliaceae	27	1.48
43	*Gentiana argenta* L.	Gentianaceae	40	2.91
44	*Geranium wallichiana* D. Don.	Geraniaceae	63	3.46
45	*Paeonia emodi* Wall. ex Royle.	Paeoniaceae	27	1.48
46	*Plantago lanceolata* L.	Plantaginaceae	54	2.96
47	*Poa supina* Schrad	Poaceae	86	4.72
48	*Skimmia laureola* (DC.) Siebold. & Zucc. ex Walp.	Rutaceae	27	1.48
49	*Acer oblongum* Wall. ex DC.	Sapindaceae	27	1.48
50	*Veronica serpyllifolia* L.	Scrophulariaceae	27	1.48
51	*Taxus fuana* (seedlings) Nan Li & R.R. Mill.	Taxaceae	31	1.70
52	*Urtica dioca* L.	Urticaceae	27	1.48
53	*Valeriana jatamansii* Jones.	Valerianaceae	27	1.48
54	*Viola biflora* L.	Violaceae	54	2.96

Table 3. List of plant families recorded from Shogran forests, their total frequency and total relative frequency (in descending order) was occupied in 22 stands.

S. No.	Family Name	Total Frequency	Total Relative Frequency
1	Rosaceae	149	8.18
2	Labiatae/Lamiaceae	125	7.57
3	Ranunculaceae	135	7.4
4	Pinaceae	121	7.35
5	Fabaceae	130	7.12
6	Primulaceae	94	5.15
7	Adoxaceae	90	4.94
8	Poaceae	86	4.72
9	Rubiaceae	85	4.66
10	Polygonaceae	71	4.61
11	Asteraceae	72	3.95
12	Geraniaceae	63	3.46
13	Brassicaceae	58	3.18
14	Caryophyllaceae	58	3.18
15	Leguminosae	58	3.18
16	Berberidaceae	54	2.96
17	Plantaginaceae	54	2.96
18	Violaceae	54	2.96
19	Gentianaceae	40	2.91
20	Taxaceae	31	1.7
21	Araliaceae	31	1.7
22	Paeoniaceae	27	1.48
23	Rutaceae	27	1.48
24	Sapindaceae	27	1.48
25	Scrophulariaceae	27	1.48
26	Urticaceae	27	1.48
27	Valerianaceae	27	1.48
28	Acanthaceae	27	1.48
29	Boraginaceae	27	1.48
30	Caprifoliaceae	27	1.48

Stands 7 to 10 were also located closed to Magri of Shogran Valley but at the elevation of 2405m. The topographic positions of the stands were on slightly higher elevation, concave land form and well drained. These were small, large open canopy gap with full light. The variation found in this stand was *Trifolium minus* which was found at higher elevation only. In these stands 18 species were recorded. The highest frequency of 70% was recorded by *Viburnum mullaha*. *Fragaria indica* and *Poa supina* were present with the frequency of 65%. The frequency of *Geranium wallichianum*, *Ranunculus pulchellus* and *Trifolium minus* were 55%. *Gentiana argenta* was occur with the frequency of 45%, *Viola biflora* with 40%, *Galium boreata*, *Gentiana argenta, Micromeria biflora*, *Rosa macrophylla, Rumex dentatus, Thalictrum alpinum* and *Trigonella foenum-graecum* with 35%. The lowest frequency (10%) was shown by *Achillea millefolium*, *Arodrosace rotundifolia*, *Galium aparine, Paeonia emodi*, *Plantago lanceolata*, *Rumex nepalensis, Skimmia laureola*, *Stellaria media, Taraxacum officinale, Urtica dioica* and *Valeriana jatamansii*. Another variation was recorded in these stands was presence of *Rumex nepalensis* which was not found in the stands recorded in lower elevation. Most of the species are the key stone species for moist temperate area, so Siddiqui *et al.* (2013) recorded these species from different locations of moist temperate areas, other than Shogran. Shafiq (2003) recorded many species from Ayubia National Park which is also considered as moist temperate area.

Stands 11 to 13 were again distributed near to Magri of Shogran Valley at the elevation of 2405m (Table 1). It was topographically mid hill slope, convex land form and well drained. From these stand 20 species of understorey vegetation were recorded (Table 2). The dominating species was *Fragaria indica,* with the frequency of 70%. *Poa supina, Trifolium repens* and *Viburnum mullaha* were present with the frequency of 65%. *Galium aparine, Geranium wallichianum, Micromeria biflora, Ranunculus pulchellus* and *Viola biflora* were growing with the frequency of 40%. *Abies pindrow* (seedling), *Plantago lanceolata* and *Podophyllum emodi* were found with 25% frequency. Siddiqui *et al.* (2013) recorded *Podophyllum emodi* from Kaghan valley which is near to Shogran valley, indicated similar environmental condition. *Anagallis arvensis, Robinia pseudoacacia, Skimmia laureola* and *Valeriana himalayana* were recorded with 20% frequency. *Acer oblongum* (seedling), *Achillea millefolium*, *Calamintha nepata*, *Thalictrum alpinum, Trigonella foenum-graecum* and *Veronica serphyllifolia* were present with 10% frequency. The lowest frequency (5%) was shown by *Acer oblongum, Berberis ceratophylla, Caltha palustris, Cedrus deodara* (seedling), *Dicliptera roxburghiana, Indigofera gerardiana, Myosotis alpestris, Potentilla nepalensis, Urtica dioica* and *Valeriana jatamansii.*

Stands 14 to 22 were recorded near to Siri of Shogran Valley at the elevation of 2784m which was highest place in the Valley (Table 1). Topographically these stands were located at low to slightly high elevation, convex and concave land form, semi shady and well drained. In these stands 15 understorey species were recorded. The maximum frequency (65%) was shown by *Viburnum mullaha* while *Fragaria indica* was present 60% frequency. *Gentiana argenta* and *Primula denticulata* were appeared with 40%, *Ajuga parviflora, Galium boreata, Paeonia emodi* and *Viola biflora* were 30%, *Arabidopsis thaliana* occupied 25%, *Lepidium sativum, Plantago lanceolata, Ranunculus pulchellus, Rumex nepalensis* and *Trifolium minus* were distributed with 20% and *Ranunculus sceleratus* was found with 15% frequency. The minimum frequency (10%) was shown by *Indigofera pulchella* and *Myosotis alpestris*. In these stands *Arabidopsis thaliana* was found at higher elevation of Siri.

Shogran valley is considered in the category of moist temperate area due to its humid environment, high rainfall and moderate temperature Siddiqui *et al.* (2013). During this study 54 understorey species were recorded belong to 30 families in which Rosaceae was dominant which occupied 149 total frequencies and 8.18% total relative frequency. In this respect the second dominant family is Labiatae followed by Ranunculaceae, Pinaceae, Fabaceae, Primulaceae, Adoxaceae, Poaceae etc. (Table 3). Family number 22 to 30 occupied less frequency and relative frequency (27 and 1.48 respectively).

Siddiqui (2011) recorded 81 understorey species from different moist temperate areas, including the seedlings of *Pinus wallichiana, Cedrus deodara, Taxus fuana, Abies pindrow* and *Picea smithiana.* The other similar species with the present study were *Hedera nepalensis, Podophyllum emodi, Rosa macrophylla, Rumex dentatus, Trifolium repens* and *Urtica dioca* but most of the species were different although the climatic condition of both the area was similar. Wahab (2011) recorded similar species from dry temperate area (Dir, Malakand division) which were *Achillea millefolium, Anagallis arvensis, Galium aparine, Indigofera gerardiana, Mentha longifolia, Micromeria biflora, Plantago lanceolata, Potentilla nepalensis, Rumex dentatus, Taraxacum officinale, Trifolium repens* and *Urtica dioica.* Hussain (2013) recorded seventy understorey species from Gilgit in which the common species were *Geranium wallichianum, Mentha longifolia,* seedlings of *Picea smithiana* and *Pinus wallichiana*, *Trifolium repense* and *Urtica dioca*. The common genera were *Berberis, Fragaria, Potentilla, Rosa, Taraxacum* and *Trifolium*. Akber (2013) studied forests vegetation from dry temperate areas (Gilgit, Astore and Skardu districts), Pakistan and recorded *Geranium wallichianum, Mentha longifolia* and seedlings of *Picea smithiana* and *Pinus wallichiana* and *Rumex dentatus.* The common genera were *Berberis, Fragaria, Potentilla, Rosa, Myosotis Podophyllum* and *Rumex.*

Urtica dioica is well known tolerate the temperate environment of both hemispheres (moist and dry) that is why recorded from all four comparable studies. *Rumex dentatus* recorded from moist temperate areas (Shogran and other areas) and dry temperate areas (Dir and Gilgit, Astore and Skardu districts) showed wide ecological amplitude. Some species were recorded from different ecological conditions that could be due to their wide ecological amplitude or high degree of anthropogenic disturbance.

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