



FLORISTIC COMPOSITION, ALTITUDINAL DISTRIBUTION, SEASONALITY AND BIOLOGICAL SPECTRUM OF THE VASCULAR FLORA OF ZAINI PASS, DISTRICT CHITRAL, PAKISTAN

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ABSTRACT

The present study was carried to explore the vascular flora of Zaini Pass, District Chitral Pakistan. For this purpose, the whole area was surveyed during 2018-2020 for the collection of plants. A total of 280 species of 195 genera and 67 families were recorded from the study area. Three (3) pteridophytes, 2 gymnosperms, 40 monocots and 233 dicots were reported. Asteraceae was the dominant family with 38 species (13.66%) followed by Papilionaceae with 21 spp. (7.55%), Lamiaceae 18 spp. (6.47%), Rosaceae 16 spp. (5.75%), Brassicaceae and Poaceae 14 spp. (5.03%) each, Apiaceae 12 spp. (4.31%), Polygonaceae 11 spp. (3.95%) and Boraginaceae 10 spp. (3.59%), while rest of the families shared less than 10 species each. Herbs were dominant in the research area and contributed 84.23%, followed by trees with 8.46% and shrubs with 7.30%. Therophytes was the most abundant life form that constituted 40.28% of the total flora, followed by hemicytrophytes and phanerophytes with 15.46% each, geophytes with 14.02%, chamaephytes with 12.94%, climbers with 1.07% and parasites with 0.71%. Nanophylls were the most abundant leaf size with 34.17% of total flora, followed by microphylls 22.30%, mesophylls 18.34%, leptophylls 16.18%, macrophylls 7.55% and aphyllous with 1.44%. Simple leaf type was leading class with 67.87%, followed by compound with 19.85%, incised with 10.82% and aphyllous with 1.44%. The study area has two flowering seasons, spring (March-May) and summer (June-August). But three categories of flowering condition were observed, most of plant species were blooming during spring season having 50% species followed by summer with 40.35% and spring and summer with 4.65%. But no flowering was recorded during autumn and winter.

Key words: Floristic composition, altitudinal distribution, biological spectrum, seasonality, vascular flora, Zaini Pass Chitral.

INTRODUCTION

District Chitral is the north most and largest district of Khyber Pakhtunkhwa province. It is bordered on the east by district Ghizer of Northern areas of Pakistan, on the south by districts of Dir and Swat. Nooristan of Afghanistan lies across the border to the West and on the north-west by the Wakhan corridor, which separates Pakistan and Tajikistan. The study area Zaini Pass is located in between two well-known Valleys of Tarich and Mulkhow. It shares their boundaries with north of mulkhow, south of Tarich, west of Gaht and east of Othul valley. Zaini Pass lies at $36^{\circ}19' 24''$ north latitude and $72^{\circ} 09' 03''$ east longitude. It has an area 51 km^2 . It is situated at an altitude of 4011 amsl. Phytogeographically, the research area comes under Irano-Turanian region, which characterizes 45.6% of the total floral diversity of Pakistan. Climate of the area is cold moderate with pleasant summer and very cold winter with snowfall. The vegetation of the area has been categorized into dry temperate open scrub, subalpine scrub, alpine herbaceous vegetation and cultivated plants (Nusser & Dickore, 2002).

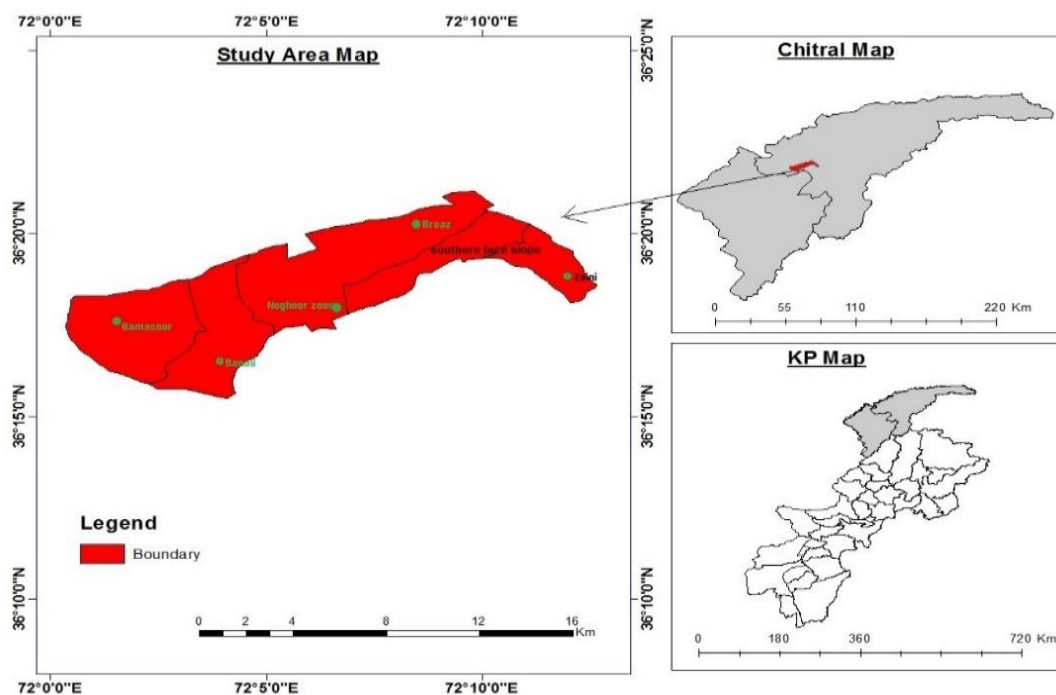


Fig 1. Map of research area Zaini Pass District Chitral

Flora is the total sum of all plants exists in any particular geographical region, both wild and cultivated. While vegetation is the distribution and number of wild plants and size of each of relative importance (Badshah *et al.*, 2013). Our planet has diversified flora having more than 300,000 estimated plant species. Human has studied about 83.3% of plant species over the world (WCMC, 1992). Pakistan has phytogeographically rich regions, especially mountainous regions has a great floral diversity. The northern mountainous regions of Pakistan consist of about 80% of total flora (Karim *et al.*, 2015). It might be due to topography,



aspects, diverse habitats and elevation. More than 6000 species are reported, among these 400 (7.8%) are endemic species (Ali & Qaiser, 1986; Stewart, 1972). The floristic regions of Pakistan are divided into six Phytogeographical regions *i.e.*, Mediterranean, Saharo-Sindian, Euro-Siberian, Irano-Turanian, Sino-Japanese and Indian (Ali & Qaiser, 1986; Nasir & Ali, 1970). Anthropogenic activities and environmental condition play important role in distribution of plants. Furthermore, abiotic factors also play a key role in the spatial distribution of species like edaphic features, topography, mountain slopes and climate change (Ullah *et al.*, 2015). Floristic checklist provides basic information of particular region to inhabitant and future researchers as well. Through this checklist researcher will easily understand about the climatic condition and geography of the area. Floristic study of any given area helps to evaluate the plant wealth and its potential values. The local plants identification and introduction of an area is very important to introduce the specific species of local area and their occurrence, growing season, finding new species and also the effect of climatic conditions like over grazing, drought and temperature on vegetation (Shaheen *et al.*, 2016).

The ratio of life form and leaf size of different species in term of numbers or percentage of any Phytogeographical region is called biological spectrum (Muhammad *et al.*, 2020). The analytical characters like leaf size and life form are collectively known as biological spectrum (Raunkiaer, 1934). The circulation of all adaptation in plants to climatic conditions is known as life form, which helps to indicate the stratification pattern of plant community, the prevailing environment, its aridity or humidity, to monitor the impact of ambient stress factor on climate and to determine the nature of bioclimate or phytoclimate (Thakur, 2015). It is an essential variation that is illustrated by the different methods available for describing vegetation. Floristic diversity and its biological spectra rely on topography and elevation. Plant life characters like life form, leaf size spectra, and phenological traits mirror the conditions of the existing ecological and natural surroundings (Iqbal *et al.*, 2018).

MATERIALS AND METHODS

The following methodology was adopted for the present research work.

a. Plant collection, identification and check list preparation

Regular surveys were carried out from March 2018 to August 2020. The plant specimens were collected, pressed, documented and preserved with Nepheline powder. The specimens were dried, mounted on herbarium sheets and identified by consulting authentic literature (Nasir & Ali, 1970-1989; Ali & Nasir, 1989-1991; Ali & Qaiser, 1993-2019). The preserved plant specimens were deposited in the herbarium of Botany Department, University of Peshawar (PUP). The checklist was accordingly prepared in chronological order.



b. Data collection regarding altitude, season, habit and biological spectrum (life form & leaf size)

During field survey GPS was used to record the altitude of each plant species. Beside that seasonal variation and habits of plants were also studied in the field. Life form shows the climatic condition of an area. The plants of the study area were classified into different life form classes based on the degree of presence and protection of perenating buds during favorable conditions following Raunkiaer (1934) and Badshah (2012).

Leaf size is a quantitative character, which was calculated by following formula

$$\text{Leaf area} = \frac{\text{length} \times \text{breadth}}{2} \times 2$$

c. Data analysis and interpretation

MS Excel data spread sheet was used for statistical analysis, percentages calculation and data was acquired for further interpretation of the results.

RESULTS

Flora is the sum total of all plant species (both wild and cultivated) exists in a specific geographic region, which shares all the resources which are available in their environment. Plant resources are affected by biotic and abiotic components of the environment such as anthropogenic activities, over grazing, deforestation and natural disasters. During field study, a total of 280 species belonging to 195 genera and 67 families were collected from study area (Table-2 & Fig. 1.). Angiosperms were 275 species, 2 were gymnosperms and 3 were Pteridophytes. Out of 275 angiosperms, 30 species were monocots and 245 species were dicots (Fig. 8.). Habit of plants showed that 236 species were herbs, 25 were trees and 19 species were shrubs (Table-2 & Fig. 7). Leaf type plant showed that 191 (67.87%) were with simple leaves, followed by compound (55 spp., 19.85%), incised (30 spp., 10.83%) and aphyllous (4 spp., 1.44%) (Table-2 & Fig. 4). Asteraceae was dominant family with 39 species, followed by Papilionaceae (21 species), Lamiaceae (18 species), Rosaceae (16 species), Brassicaceae and Poaceae with 14 species each, Apiaceae (12 species), Polygonaceae (11 species) and Boraginaceae (10 species). Thirty (30) families were with 2-9 species, while remaining 30 families were represented by only 1 species each. The study area has two flowering seasons, spring (March- May) and summer (June-August). But three categories of flowering conditions were observed, maximum (50%) species bloom during spring season, followed by 40.35% in summer and 4.65% species in both spring and summer. But no flowering was recorded during autumn and winter (Table-1 & Fig. 3). According to Raunkiaer, s methods of life form 10 different classes were recorded from study area. The dominant life form was therophytes with 112 species (40.28%),

followed by hemicryptophytes 43 species (15.46%), geophytes 39 species (14.02%), chamaephytes 36 species (12.94%), mesophanerophytes 19 species (6.83%), nanophanerophytes 11 species (3.95%), megaphanerophytes 7 species (2.51%), climbers 3 species (1.07%) and parasites 2 species (0.71%) (Table-2 & Fig. 6). Leaf size spectra showed that, nanophylls was dominated leaf size class with 95 species (34.17%), followed by macrophyll with 62 species (22.30%), mesophylls 51 species (18.34%), leptophyll 45 species (16.18%), macrophyll 21 species (7.55%) and aphyllous 4 species (1.43%) (Table-2 & Fig. 5). Ten (10) endemic species including *Pimpinella stewartii*, *Anaphalis chitralensis*, *Cousinia chitralensis*, *Calamagrostis decora*, *Androsace himalaica*, *Androsace staintonii*, *Tricholepis tibetica*, *Allium chitralicum*, *Rhodiola tibetica* and *Draba pakistanica* were also collected from the research area (Table-2 & Fig 2).

The reports of Hussain *et al.* (2015); Ullah & Safeer (2016) and Badshah *et al.* (2016) strongly support our finding. They also found these families as well diverse in their research areas. Our findings are congruent with Shaheen *et al.* (2016), Hussain *et al.* (2016), Mahmood *et al.* (2016), Hussain *et al.* (2015) and Ali *et al.* (2015) with respect to first two dominant families, they also reported same families from other research areas as dominant families. As Asteraceae was dominating family of the present study area, Anwar *et al.* (2019), Abbas *et al.* (2019), Samad *et al.* (2018), Saeed *et al.* (2018), Frooq *et al.* (2017), Ali *et al.* (2016), Ijaz *et al.* (2016), Iqbal *et al.* (2015), Badshah *et al.* (2016), Shaheen *et al.* (2016), Karim *et al.* (2015), Mahmood *et al.* (2015), Sher *et al.* (2014), and Shaheen & Shanwari (2012) also found Asteraceae as a dominant family during their research studies. It is clear from present study that leading families were dicots (56 families) followed by monocots (8 families), pteridophytes (3 families) and gymnosperms (2 families) respectively. Our findings are in line with Nazir *et al.* (2014), as they also found same result from their research area. The results of Mahmood *et al.* (2015), Bhellum (2014) and Ali *et al.* (2018) are congruent with our findings, they also reported dicots as dominant group followed by monocots. The flora of research area consisted of 195 genera (Table-1). Among them *Nepeta*, *Prunus*, *Astragalus*, *Rhodiola* and *Artemisia* were leading genera with (6, 5, 4, 4 and 4 species) respectively. Our results consistently supported by Hussain *et al.* (2015), as he found same genera as more diverse in their study area. Same number of species of *Rhodiola* and *Artemisia* were reported by Khan *et al.* (2016) and Nawab *et al.* (2017), from their studied areas, which further support our work. Study area showed 236 species of herbs, 25 species trees and 19 species of shrubs (Table-2 & Fig. 4). The finding of Saeed *et al.* (2018) strongly support the present results. They also found herbs as the divers group followed by trees and shrubs. Khan *et al.* (2015) studied the floral diversity of District Kotli, Azad Jammu Kashmir. They also reported herbs as most dominated habit class, followed by trees and shrubs. On the basis of leaf lamina plant species showed 191 (67.87%) simple leaves, followed by compound (55 spp., 19.85%), incised (30 spp., 10.83%) and aphyllous (4 spp., 1.44%) (Table-2 & Fig. 5). Badshah *et al.* (2013) classified the leaf type (Lamina) of Tank vegetation. They reported simple leaf as dominant followed by compound leaf. In the study of Ali *et al.* (2016) simple



lamina (305 spp.) was also reported as dominant class. The above discussed research is also in accordance to present findings. In the present findings dominant life form was therophytes with 112 species (40.28%), followed by hemicryptophytes 43 species (15.46%), Geophytes 39 species (14.02%), chemophytes 36 species (12.94%), mesophanarophytes 19 species (6.83%), nanophanarophytes 11 species (3.95%), megaphanarophytes 7 species (2.51%), microphanarophytes 6 species (2.15%), climbers 3 species (1.07% and parasites 2 species (0.71%) (Table-2 & Fig. 6). The dominance of therophytes followed by hemicryptophytes and geophytes were also described by Hussain *et al.* (2015), Hadi *et al.* (2014) and Sher *et al.* (2011) from their research areas. Their findings strongly support our results, because both research areas fall in same altitude and having dry climatic condition. These life forms are characteristics of hilly and dry climatic geographical regions. The leaf spectra of Zaini Pass, showed that nanophyll was the most dominant class with 95 spp. (34.17%), followed by microphyll 62 spp. (22.30%), mesophyll 51 spp. (18.34%), leptophyll 45 spp. (16.18%), macrophyll 21 spp. 7.55%) and aphyllous 4 spp. (1.43%) (Table-2 & Fig. 7). Similar results reported by Samreen *et al.* (2018), Hussain *et al.* (2015), Hadi and Ibrar (2017) and Badshah *et al.* (2013). They found all 3 mentioned life size classes as leading classes. Their findings strongly support our result because all these areas fall in dry climatic conditions. The research area falls in Irano-Turanian region, which is famous for endemic species. Ten endemic species were reported from present study area by Rahman *et al.* (2020) *Pimpinella stewartii*, *Anaphalis chitralensis*, *Cousinia chitralensis*, *Calamagrostis decora*, *Androsace himalaica*, *Androsace staintonii*, *Tricholepis tibetica*, *Allium chitralicum*, *Rhodiola tibetica* and *Draba pakistanica* (Table-2 & Fig. 2).

The papers of Dissanayake & Hettiarachchi (2013) and Al Hawshabi (2017) also supports to our result, they reported 19 and 16 endemic species from their research areas. Phenology is a condition of periodic moment of plant species, like when they are flowering, budding and formation of seeds etc. The research area comes in temperate, sub- alpine and Alpine region. Due to harsh climatic condition and earlier snow fall, plant species modify or adjust themselves with their environment. Flowering condition has been observed in only two seasons. The study area has two flowering seasons, spring (March-May) and summer (June-August). The findings of many other research studies *i.e.*, (Muhammad *et al.*, 2020; Haq *et al.*, 2020; Khan *et al.*, 2020; Khan & Ullah, 2019; Badshah *et al.*, 2016; & Shaheen *et al.*, 2016) are in accordance to the present study.

Table-1: Floristic list and ecological characteristics of vascular plants of Zaini Pass, District Chitral, Pakistan

S#	Family/Botanical name	1	2	3	4	5	6	7
Pteridophytes								
1. Adiantaceae								
1	<i>Adiantum venustum</i> D. Don	H	G	N	C	Su	2340m	R
2. Equisetaceae								
2	<i>Equisetum ramossimum</i> Desf.	H	G	N	A	Su	2121m	Co
3. Athyriaceae								
3	<i>Athyrium filix-femina</i> (L.) Roth	H	Ch	Mic	C	Su	4012m	Co
Gymnosperms								
4. Cupressaceae								
4	<i>Juniperus excelsa</i> M.Bieb	T	MP	A	I	Su	3021m	R
5. Ephedraceae								
5	<i>Ephedra intermedia</i> Schrenk & Meyer	S	Ch	Mic	A	Su	2731m	R
Angiosperms (Monocots)								
6. Amaryllidaceae								
6	<i>Allium carolinianum</i> DC.	H	G	Mes	S	Su	4021m	F
7	<i>Allium cepa</i> Linn.	H	G	Mes	S	Su	2312m	Co
8	<i>Allium chitralicum</i> Wang & Tang	H	G	N	S	Su	4002m	R
7. Asphodelaceae								
9	<i>Asphodelus tenuifolius</i> Cav.	H	G	Mic	S	Su	2341m	Inf
10	<i>Eremurus stenophyllus</i> (Boiss. & Buhse) Baker	H	G	Mic	S	Su	3423m	Co
11	<i>Gagea</i> spp.	H	G	N	S	Sp	3012m	R
12	<i>Tulipa stellata</i> Hook.	H	G	L	S	Sp	2324m	Inf
13	<i>Tulipa</i> sp.	H	G	Mic	S	Sp	3212m	R
8. Cyperaceae								
14	<i>Bolboschoenus glaucus</i> (Lam.) S.G.Sm.	H	G	Mic	S	Su	2453m	Inf
9. Colchicaceae								
15	<i>Colchicum laetum</i> Steven	H	G	N	S	Su	3212m	R
10. Iridaceae								
16	<i>Iris germanica</i> L.	H	G	Mes	S	Sp	2321m	Inf
17	<i>Iris songarica</i> Schrenk	H	G	Mes	S	Sp	2212m	C
11. Orchidaceae								
18	<i>Epipactis</i> Spp	H	G	Mes	S	Su	2345m	R
19	<i>Epipactis veratrifolia</i> Boiss. & Hohen.	H	Ch	Mic	S	Su	2678m	R
20	<i>Malaxis muscifera</i> (Lindl.) O. Kuntze	H	G	Mic	S	Sp	2023m	R
12. Orobanchaceae								
21	<i>Cistanche tubulosa</i> (Schrenk) Hook.f.	H	PS	Aph	A	Su	3365m	R
13. Poaceae								
22	<i>Avena fatua</i> L.	H	Th	N	S	Sp	2132m	Co



23	<i>Avena sativa</i> L.	H	Th	Mes	S	Sp	2356m	Co
24	<i>Bromus intermedius</i> Gussone.	H	Th	Mes	S	Sp	2146m	Co
25	<i>Bromus japonicas</i> L.	H	Th	Mes	S	Sp	2764m	Co
26	<i>Calamagrostis epigeous</i> (L.) Roth	H	G	Mes	S	Su	2256m	R
27	<i>Calamagrostis dicora</i> Hook.f.	H	G	Mes	S	Su	2456m	Co
28	<i>Cynodon dactylon</i> (Linn.) Pers.	H	H	Mic	S	Sp	2563m	Co
29	<i>Echinochloa crus-galli</i> (L.) Beauv	H	Th	N	S	Su	2734m	R
30	<i>Hordeum spontaneum</i> C.Koch.	H	Th	Mes	S	Sp	2561m	Co
31	<i>Poa bulbosa</i> Linn.	H	C	Mic	S	Sp	2643m	Co
32	<i>Polypogon fugax</i> Nees ex Steud.	H	Th	Mic	S	Su	2982m	R
33	<i>Polypogon monspeliensis</i> (L.) Desf.	H	Th	Mic	S	Su	2642m	Co
34	<i>Triticum aestivum</i> L.	H	Th	Mes	S	Sp	2546m	Co
35	<i>Zea mays</i> L.	H	Th	M	S	Su	2652m	Co
Angiosperm (Dicots)								
14. Amaranthaceae								
36	<i>Amaranthus viridis</i> L.	H	Th	Mes	S	Su	2902m	Co
15. Anacardaceae								
37	<i>Pistacia integerrhima</i> J. L. Stewart ex Brandis.	T	MaP	Mic	C	Sp	2874m	R
16. Apiaceae								
38	<i>Ammi visnaga</i> (L.) Lam.	H	Th	N	I	Su	2432m	Co
39	<i>Bonium persicum</i> (Boiss.) B.Fedtsch.	H	G	N	I	Su	2652m	Co
40	<i>Ferula jaeschkeana</i> Vatke.	H	G	Mes	C	Sp	3212m	R
41	<i>Ferrula nortex</i> Royle.	H	G	L	C	Sp	3212m	R
42	<i>Foeniculum vulgare</i> Miller	H	G	N	I	Sp	3212m	R
43	<i>Pimpinella stewartii</i> Dunn. Nasir.	H	Th	N	C	Sp	3211m	Co
44	<i>Prongos pabularia</i> Lindl.	H	Hem	N	C	Su	3213m	Co
45	<i>Scandix pecten-veneris</i> L.	H	Th	N	C	Su	2312m	Co
46	<i>Seseli diffusum</i> (Roxb. ex Sm.) Santapau & Wadhwa	H	Th	L	C	Su	2876m	Co
47	<i>Torilis arvensis</i> (Huds.) Link	H	Th	Mic	C	Sp	3241m	Co
48	<i>Torilis leptophylls</i> (L.) Rafin.	H	Th	Mic	C	Sp	2876m	Co
49	<i>Trachyspermum ammi</i> L.	H	G	N	C	Su	2316m	R
17. Apocynaceae								
50	<i>Vinca major</i> L.	H	Th	Mes	S	Sp	2134m	Co
51	<i>Cynanchum acutum</i> L.	H	Ch	Mic	S	Su	2681m	R
18. Asteraceae								
52	<i>Achillea millefolium</i> L.	H	He	N	C	Su	2673m	Inf
53	<i>Ajania fruticulosa</i> (Ledeb.) Poljakov	H	He	N	I	Su	3241m	Inf
54	<i>Anaphalis chitralensis</i> Qaiser & Rubina Abid	H	Ch	Mic	S	Su	3452m	Inf
55	<i>Artemisia brevifolia</i> Wall ex DC.	H	Ch	L	I	Su	3212m	Co
56	<i>Artemisia indica</i> Willd.	H	Ch	N	I	Su	2342m	Co
57	<i>Artemisia maritima</i> L.	H	Ch	N	I	Su	3451m	Co



58	<i>Artemisia scoparia</i> Waldst. & Kit.	H	Ch	N	I	Su	2234m	Co
59	<i>Bellis perennis</i> L.	H	Th	Mic	S	Sp	2141m	Inf
60	<i>Calendula officinalis</i> L.	H	Th	Mes	S	Sp	2321m	R
61	<i>Carthamus tinctorius</i> L.	H	Th	Mic	S	Su	2134m	Inf
62	<i>Carduus edelbergii</i> DC.	H	Ch	Mic	S	Su	2311m	Co
63	<i>Centaurea calcitrapa</i> L.	H	Th	N	I	Su	2541m	Co
64	<i>Ceratocephalus falcata</i> (L.) Prs.	H	Th	N	I	Sp	2621m	R
65	<i>Cirsium acaule</i> (Linn.) Scop.	H	Th	Mac	S	Sp	2312m	Inf
66	<i>Cichorium intybus</i> L.	H	Th	Mes	S	Su	2561m	Inf
67	<i>Conyza canadensis</i> (L.) Cronquist	H	Th	N	S	Su	2524m	Co
68	<i>Cousinia buphthalmoides</i> Regel.	H	Th	L	S	Su	3451m	Co
69	<i>Cousinia chitralensis</i>	H	Th	L	S	Su	4213m	Inf
70	<i>Cousinia thomsonii</i> C.B. Clarke.	H	Th	L	S	Su	4001m	Inf
71	<i>Echinops cornigerus</i> DC.	H	Th	Mic	S	Su	4213m	R
72	<i>Echinops echinatus</i> Roxb.	H	Th	Mac	S	Su	3121m	Inf
73	<i>Erigeron uniflorus</i> L.	H	Th	L	S	Sp	2314m	R
74	<i>Helianthus annuus</i> L.	H	Th	Mes	S	Su	2371m	Co
75	<i>Iflago spicata</i> (Forssk.) Sch.Bip.	H	Th	L	S	Sp	2781m	Co
76	<i>Koelpinia linearis</i> Pallas	H	Th	L	S	Sp	2452m	Co
77	<i>Lactuca dissecta</i> D. Don	H	Th	Mes	S	Su	2671m	R
78	<i>Lactuca orientalis</i> Boiss	H	Th	Mes	S	Sp	2732m	Inf
79	<i>Launaea procumbens</i> (Roxb.) Ramayya & Rajagopal	H	Th	N	I	Sp	2541m	R
80	<i>Matricaria chamomilla</i> L.	H	Th	N	I	Sp	2431m	Co
81	<i>Myriactis wallichii</i> Less.	H	Th	N	S	Su	2542m	R
82	<i>Pentanema vestitum</i> (Wall. ex DC.) Ling	H	He	Mic	S	Sp/Su	2341m	R
83	<i>Sonchus arvensis</i> L.	H	Th	Mic	I	Su	2341m	Co
84	<i>Soncus asper</i> (L.) Hill	H	Th	Mec	I	Sp	2761m	Co
85	<i>Tanacetum artemisioides</i> Schultz-Bip. ex Hook. f.	H	Ch	N	S	Su	3214m	Inf
86	<i>Tagetes erecta</i> L.	H	Th	N	I	Sp/Su	3214m	Co
87	<i>Taraxacum officinale</i> Weber	H	G	Mes	S	Sp	2346m	Co
88	<i>Tricholepis tibetica</i> J. D. Hooker & Thomson ex C. B. Clarke *	H	H	N	S	Sp/Su	3765m	Inf
89	<i>Tricholepis tupinae</i> Fisch.	H	H	N	S	Sp/Su	3541m	R
90	<i>Tussilago farfara</i> L.	H	Th	N	S	Su	2651m	Inf
19. Berberidaceae								
91	<i>Berberis lycium</i> Royle	S	NP	N	S	Sp	2789m	Co
20. Butalaceae								
92	<i>Betula utilis</i> D. Don.	T	MeP	Mes	S	Su	2752m	R
21. Boraginaceae								
93	<i>Buglossoides arvensis</i> L.	H	Ch	N	S	Sp	2654m	Co
94	<i>Boglosodies officinales</i>	H	Th	N	S	Sp	3251m	Co

95	<i>Cynoglossum lanceolatum</i> Forssk	H	H	Mic	S	Sp	2787m	R
96	<i>Cynoglossum glochidiatum</i> Wall. ex Benth	H	H	N	S	Sp	2451m	R
97	<i>Heliotropium cabulicum</i> Griffith	H	H	L	S	Sp	2764m	Inf
98	<i>Heliotropium glabellum</i> R.Br.	H	H	L	S	Sp	2983m	R
99	<i>Heliotropium europium</i> L.	H	H	L	S	Sp/Su	3569m	Inf
100	<i>Nonea edgeworthii</i> A. DC.	H	H	N	S	Sp	2563m	R
101	<i>Onosma hispida</i> Wall ex G. Don	H	H	N	S	Sp	2431m	Inf
102	<i>Paracaryum rugulosum</i> (DC.) Boiss	H	Th	N	S	Sp	3214m	R
22. Brassicaceae								
103	<i>Alliaria petiolata</i> (M.Bieb)	H	Th	Mic	S	Sp	2431m	Co
104	<i>Brassica napus</i> L.	H	Th	Mic	S	Su	2671m	Co
105	<i>Cardaria chalepense</i> (L.) Hand.Mazz.	H	Th	Mic	S	Sp	2782m	Inf
106	<i>Capsella bursa-pastoris</i> (L.) Medic	H	Th	Mec	I	Sp	2313m	Co
107	<i>Chorispora macropoda</i> Trautv.	H	Th	N	S	Sp	2564m	R
108	<i>Descurainia sophia</i> (L.) Webb & Berth	H	Th	N	I	Su	2751m	Co
109	<i>Draba pakistanica</i> Jafri.	H	Th	L	S	Sp/Su	4012m	Inf
110	<i>Iberis amara</i> L.	H	Th	Mic	I	Sp	2451m	R
111	<i>Lepidium sativum</i> L.	H	Th	N	S	Sp	2321m	Co
112	<i>Malcolmia africana</i> (L.) R. Br	H	Th	L	S	Sp	2821m	Co
113	<i>Neslia apiculata</i> Fisch., C.A. Mey.	H	Th	L	S	Sp	2314m	Co
114	<i>Raphanus raphanistrum</i> L.	H	Th	N	I	Sp	2315m	Inf
115	<i>Raphanus sativus</i> L. var. sativus	H	Th	Mac	I	Sp	2441m	Co
116	<i>Sisymbrium irio</i> L.	H	Th	L	I	Sp	2731m	Co
23. Capparidaceae								
117	<i>Capparis spinosa</i> L.	H	H	Mec	S	Su	2341m	Co
118	<i>Cleome ariana</i> Hedge & Lamond	H	H	N	S	Sp	2541m	Inf
24. Caprifoliaceae								
119	<i>Viburnum grandiflorum</i> Wall. ex DC.	S	NP	Mes	S	Sp	2541m	R
120	<i>Lonicera japonica</i> Thunb.	S	Cl	Mic	S	Sp	2742m	Co
121	<i>Lonicera</i> sp.	S	NP	Mic	S	Sp	2721m	Co
25. Caryophyllaceae								
122	<i>Cerastium pusillum</i> Ser.	H	Th	N	S	Sp	3214m	Inf
123	<i>Lepyrodicilis holosteoides</i> C.A. Mey.	H	Th	N	S	Sp	3215m	Inf
124	<i>Petrorhagia alpine</i> L.	H	G	Mic	S	Sp	3214m	Co
125	<i>Silene conoidea</i> L.	H	Th	N	S	Sp	2631m	Co
126	<i>Stellaria media</i> (L.) Vill.	H	Th	N	S	Sp	2542m	Co
26. Chenopodiaceae								
127	<i>Chenopodium album</i> L.	H	Th	N	S	Sp	2321m	Co
128	<i>Chenopodium botyre</i> L.	H	Th	N	S	Sp	2731m	Co
129	<i>Bassia scoparia</i> (L.) A.J.Scott	H	Th	L	S	Su	2314m	Co
27. Convolvulaceae								
130	<i>Convolvulus arvensis</i> L.	H	Th	Mic	S	Sp	2672m	Co

28. Crassulaceae								
131	<i>Rhodiola heterodonta</i> (Hook.f., & Thomson) Boriss.	H	He	N	S	Su	4231m	Co
132	<i>Rhodiola</i> Sp	H	He	N	S	Su	4213m	Co
133	<i>Rhodiola tibetica</i> (Hook.f. & Thomson) S. H. FU	H	He	L	S	Su	4231m	Co
134	<i>Rhodiola wallichiana</i> (Hook.) S.H	H	He	L	S	Su	4123m	Inf
29. Cuscutaceae								
135	<i>Cuscuta reflexa</i> Roxb.	H	PS	Aph	A	Sp	2631m	Co
30. Ebenaceae								
136	<i>Diospyros kaki</i> L. F.	T	MeP	Mes	S	Sp	2532m	Co
31. Elaeagnaceae								
137	<i>Elaeagnus angustifolia</i> L.	T	MeP	Mes	S	Sp	2671m	Co
138	<i>Hippophae rhamnoides</i> subsp. turkestanica Rousi	S	MiP	N	S	Sp	2316m	Co
32. Euphorbiaceae								
139	<i>Euphorbia falcata</i> L.	H	Th	N	S	Sp	3210m	Inf
33. Fumariaceae								
140	<i>Corydalis gowaniana</i> Wall ex Trend.	H	G	L	I	Sp	4212m	FR
141	<i>Corydalis crassifolia</i> Royle	H	Ch	Mic	S	Sp/Su	4023m	R
142	<i>Corydalis</i> sp.	H	Ch	Mic	S	Sp/Su	4002m	Inf
143	<i>Fumaria indica</i> (Hauskn.) L.	H	Th	L	I	Sp	2341m	Co
34. Gentianaceae								
144	<i>Centaurium pulchellum</i> (Sw.) Druce	H	Th	N	S	Sp	2671m	R
145	<i>Swertia alata</i> (G. Don) Clarke in Hook.f.	H	G	N	S	Sp	2431m	R
35. Geraniaceae								
146	<i>Geranium pratense</i> L.	H	Th	Mes	C	Sp	3541m	Co
147	<i>Geranium rotundifolium</i> L.	H	Th	N	C	Sp	3671m	Co
148	<i>Geranium wallichianum</i> D. Don ex Sweet.	H	Th	Mes	C	Sp	3421m	Co
36. Grossulariaceae								
149	<i>Ribes orientale</i> Desf.	S	NP	Mes	C	Su	2541m	Co
37. Hyparaceae								
150	<i>Hypericum scabrum</i> L.	H	H	N	S	Su	3421m	Co
38. Juglandaceae								
151	<i>Juglans regia</i> L.	T	MaP	Mac	C	Sp	2763m	FR
39. Lamiaceae								
152	<i>Alajja rhomboidea</i> (Benth.) Ikonn.	H	G	N	S	Sp/Su	3932m	Co
153	<i>Eremostachys edelbargii</i> Rech.	H	Ch	Mic	C	Su	3762m	Co
154	<i>Lagochilus cabulicus</i> Benth.	H	Ch	Mic	I	Su	3541m	Co
155	<i>Lamium amplexicaule</i> L.	H	Th	N	S	Sp	2761m	Co
156	<i>Mentha arvensis</i> L.	H	Th	N	S	Sp	2451m	Co
157	<i>Mentha longifolia</i> (L.) L.	H	Ch	N	S	Sp	2341m	Co
158	<i>Mentha royleana</i> Benth.	H	G	N	S	Su	2431m	Co

159	<i>Nepeta bractiata</i> Benth	H	Th	N	S	Su	3876m	Co
160	<i>Nepeta cataria</i> L.	H	Ch	Mes	S	Su	2347m	Co
161	<i>Nepeta floccosa</i> Benth	H	He	Mic	S	Su	3861m	Inf
162	<i>Nepeta kokanica</i> Regel	H	Th	N	S	Su	3890m	Inf
163	<i>Nepeta longibracteata</i> Benth.	H	He	N	S	Su	4213m	Inf
164	<i>Nepeta paulsenii</i> Briq.	H	Ch	N	S	Su	3467m	R
165	<i>Ocimum basilicum</i> L.	H	Ch	N	S	Sp/Su	3452m	Co
166	<i>Otostegia limbata</i> (Bth.) Boiss.	H	Ch	N	S	Sp	3241m	Inf
167	<i>Prunella vulgaris</i> L.	H	Ch	Mic	S	Sp	2671m	R
168	<i>Scutellaria heydei</i> Hook. f.	H	He	N	S	Su	3762m	Inf
169	<i>Scutellaria multicaulis</i> Boiss.	H	H	L	S	Su	3421m	R
40. Linaceae								
170	<i>Linum perenne</i> L.	H	Ch	L	S	Su	3213m	Co
171	<i>Linum usitatissimum</i> L.	H	Th	N	S	Su	3521m	Co
41. Malvaceae								
172	<i>Alcea rosea</i> (Linn.) Cav.	H	H	Mac	C	Su	2541m	Co
173	<i>Malva neglecta</i> Wall.	H	Th	Mec	C	Sp	2762m	Co
42. Moraceae								
174	<i>Ficus carica</i> L.	S	MeP	Mac	S	Su	2561m	Co
175	<i>Ficus palmate</i> Forsskål	S	Mep	Mac	S	Su	2571m	Inf
176	<i>Morus alba</i> L.	T	Mep	Mac	S	Sp	2614m	Co
177	<i>Morus nigra</i> L.	T	Mep	Mac	S	Sp	2621m	Inf
43. Oleaceae								
178	<i>Fraxinus xanthoxyloides</i> Wall ex G. Don.	T	Mep	Mic	C	Sp	2631m	Co
179	<i>Ligustrum ovalifolium</i> Hassk.	H	MiP	Mic	C	Sp	2613m	Co
44. Onagraceae								
180	<i>Epilobium royleanum</i> Hausskn.	H	He	Mic	S	Sp	2451m	Inf
181	<i>Epilobium hirsutum</i> L.	H	Th	N	S	Su	2521m	Co
45. Papaveraceae								
182	<i>Papaver decaisnei</i> Hochst. & Steud. ex Boiss.	H	Th	N	S	Su	2671m	Inf
183	<i>Papaver dubium</i> S.A. Sultan	H	Th	N	S	Sp	781m	R
184	<i>Papaver nudicaule</i> L.	H	H	L	I	Su	3541m	R
46. Papilionaceae								
185	<i>Astragalus purpurascens</i> Bunge	H	H	N	C	Sp	3671m	Inf
186	<i>Astragalus candolleanus</i> Royle ex Bth.	H	H	L	C	Su	3651m	Co
187	<i>Astragalus psilocentros</i> Y. J. Nasir	H	H	L	C	Su	3692m	Inf
188	<i>Astragalus xanthoiphidopsis</i> Rech.	H	Ch	N	C	Su	4231m	R
189	<i>Chesneya depressa</i> (Oliver.) Popov	H	H	L	S	Sp	3214m	R
190	<i>Cicer microphyllum</i> Benth.	H	H	L	C	Su	3241m	R
191	<i>Lotus corniculatus</i> L.	H	H	L	S	Sp	2331m	Co
192	<i>Medicago lupulina</i> L.	H	Th	N	C	Sp	2341m	FR

193	<i>Medicago polymorpha</i> L.	H	Th	N	C	Sp	2432m	Co
194	<i>Medicago sativa</i> L.	H	H	N	C	Sp	2132m	FR
195	<i>Melilotus indica</i> (L.) All.	H	Th	N	C	Sp	2432m	Co
196	<i>Oxytropis tatarica</i> Camb ex Bunge	H	H	L	C	Su	4012m	Inf
197	<i>Oxytropis cachemiriana</i> Cambessedes	H	H	L	C	Su	4132m	Inf
198	<i>Pisum sativum</i> L.	H	Th	Mic	S	Sp	2317m	Co
199	<i>Robinia pseudoacacia</i> L.	T	MeP	Mac	C	Sp	2387m	Co
200	<i>Sophora mollis</i> (Royle.) Baker	S	MiP	N	C	Sp	34321m	Co
201	<i>Psoralea drupacea</i> Bunge	H	Ch	Mes	S	Sp	2341m	Inf
202	<i>Trifolium alexandrinum</i> L.	H	Th	Mic	C	Sp	2376m	Co
203	<i>Trifolium pratense</i> L.	H	Th	N	C	Sp	2512m	Co
204	<i>Trifolium repens</i> L.	H	Th	Mic	C	Sp	2312m	Co
205	<i>Vicia sativa</i> L.	H	Th	N	S	Sp	2615m	Co
47. Plantaginaceae								
206	<i>Plantago lanceolata</i> L.	H	Th	Mic	S	Su	2321m	Co
207	<i>Plantago major</i> L.	H	G	Mac	S	Su	2551m	Co
208	<i>Veronica biloba</i> Schreb.	H	Th	L	S	Sp	2655m	Inf
209	<i>Veronica beccabunga</i> L.	H	G	Mic	S	Sp	3211m	Co
210	<i>Veronica persica</i> Poir.	H	Th	N	S	Sp	2541m	Inf
48. Platanaceae								
211	<i>Platanus orientalis</i> L.	T	MaP	Mac	S	Sp	2671m	Co
49. Plumbaginaceae								
212	<i>Acantholimon lycopodioides</i> (Girad) Boiss.	H	Ch	L	S	Su	3421m	Co
50. Polygonaceae								
213	<i>Koenigia delictula</i> (Meisn.) H. Hara	H	Th	N	S	Su	3751m	Inf
214	<i>Oxyria digyna</i> (L.) Hill	H	Th	N	S	Su	3812m	R
215	<i>Polygonum afghanicum</i> Meiss.	H	Th	L	S	Su	2761m	R
216	<i>Polygonum aviculare</i> L.	H	Th	L	S	Su	2413m	Co
217	<i>Polygonum cognatum</i> Subsp Chitralicum (Rech. F. Schiman- Czeika)	H	Hem	L	S	Su	2651m	Inf
218	<i>Polypogon fogax</i> Nees ex Steud.	H	Th	Mic	S	Su	2783m	R
219	<i>Polypogon</i> sp.	H	Th	Mic	S	Su	2556m	Inf
220	<i>Pteropyrum olivieri</i> Jaub & Sp.	S	NP	L	S	Sp	3021m	Inf
221	<i>Rheum emodi</i> Wall ex Meissn.	H	G	Mac	C	Su	3127m	Co
222	<i>Rheum tibeticum</i> Maxim	H	G	Mac	C	Su	3521m	Inf
223	<i>Rumex dantatus</i> L.	H	Ch	Mac	S	Sp	2354m	FR
224	<i>Rumex hastatus</i> D. Don	H	Ch	Mic	S	Sp	2321m	Co
225	<i>Androsace himalaica</i> (Knuth) Handel- Mazzetti	H	Ch	N	S	Su	3126m	Inf
226	<i>Androsace staintonii</i> Y. Nasir	H	Ch	N	S	Su	3423m	R
227	<i>Primula macrophylla</i> D. Don	H	H	Mec	S	Sp	3124m	Inf
228	<i>Primula rosea</i> Royle.	H	H	Mic	S	Sp	3213m	Co
51. Puniaceae								



229	<i>Punica granatum</i> L.	H	MeP	Mec	S	Sp	2345m	Co
52. Ranunculaceae								
230	<i>Anemone biflora</i> D. Don	H	H	Mec	I	Sp	3012m	Inf
231	<i>Aconitum heterophyllum</i> Wall ex Royle	H	H	Mec	I	Su	3123m	Inf
232	<i>Adonis aestivalis</i> L.	H	Th	Mic	C	Sp	2673m	Inf
233	<i>Aquilegia moorcroftiana</i> Wall.	H	Ch	Mic	C	Su	3783m	Inf
234	<i>Clematis orientalis</i> L.	H	NP	N	C	Sp	2570m	Co
235	<i>Delphinium brunonum</i> Royle	H	Ch	Mic	I	Su	3214m	Co
236	<i>Ranunculus laetus</i> Wall. ex Hook.f. & Thoms.	H	H	Mic	S	Su	2652m	Co
237	<i>Ranunculus arvensis</i> L.	H	G	L	I	Sp	2743m	Co
238	<i>Thalictrum alpinum</i> L.	H	Th	N	I	Su	3213m	Inf
53. Rosaceae								
239	<i>Agrimonia eupatoria</i> L.	H	He	N	C	Su	3212m	Co
240	<i>Cotoneaster microphylla</i> Wall.ex Lind	S	NP	L	S	Sp	2643m	Co
241	<i>Cotoneaster nummularia</i> Fisch. & C.A. Mey	S	NP	N	S	Sp	2783m	Co
242	<i>Crataegus songarica</i> K. Koch.	T	MeP	Mes	C	Sp	3215m	Co
243	<i>Fragaria nubicola</i> Y. J. Nasir.	H	Ch	Mes	S	Sp	2754m	Inf
244	<i>Mallus pumila</i> Mill.	T	MeP	Mac	S	Sp	2732m	Co
245	<i>Potentilla bifurca</i> L.	H	Ch	Mec	C	Su	2443m	Inf
246	<i>Poterium sanguisorba</i> L.	H	Th	Mic	C	Sp	2743m	Co
247	<i>Prunus amygdalus</i> Batsch.	T	MeP	Mes	S	Sp	2341m	Co
248	<i>Prunus armanica</i> L.	T	MaP	Mes	S	Sp	2764m	Co
249	<i>Prunus avium</i> L.	T	MeP	Mes	S	Sp	2531m	Inf
250	<i>Prunus domestica</i> L.	T	MeP	Mic	S	Sp	2973m	Co
251	<i>Prunus persica</i> (Linn.) Batsch	T	MeP	Mes	S	Sp	2341m	Co
252	<i>Pyrus communis</i> L.	T	MeP	Mac	S	Sp	2864m	Co
253	<i>Rosa indica</i> L.	S	NP	Mes	C	Sp	2522m	Co
254	<i>Rosa webbiana</i> Wall.ex Royle	S	NP	N	C	Sp	2743m	Co
255	<i>Sorbaria tomentosa</i> (Lindl.) Rehder	S	Ch	N	C	Sp	2312m	R
54. Rubiaceae								
256	<i>Galium aparine</i> L.	H	Th	N	S	Sp	2753m	Co
55. Salicaceae								
257	<i>Populus</i> Sp.	T	MaP	Mes	S	Sp	2743m	R
258	<i>Populus alba</i> L.	T	MaP	Mes	S	Sp	2362m	Co
259	<i>Populus ciliata</i> Wall. Ex Royal	T	MaP	Mac	S	Sp	2864m	FR
260	<i>Salix iliensis</i> Regel.	S	MeP	Mes	S	Sp	2784m	Co
261	<i>Salix babylonica</i> L.	T	Mep	Mes	S	Sp	3012m	Co
56. Saxifragaceae								
262	<i>Saxifraga hirsuta</i> L.	H	G	Mic	S	Sp	2853m	Inf
263	<i>Bergenia himalaica</i> Boriss.	H	G	Mic	S	Sp	2643m	Inf
57. Scrophulariaceae								
264	<i>Antirrhinum majus</i> L.	H	Th	L	S	Su	2833m	Co

265	<i>Linaria simplex</i> (M.B.) Fisch	H	Th	L	S	Sp	2341m	Inf
266	<i>Linaria vulgaris</i> Miller.	H	Th	L	S	Sp	2871m	R
267	<i>Verbascum thapsus</i> L.	H	G	Mac	S	Su	3012m	Co
268	<i>Veronica biloba</i> L.	H	Th	L	S	Sp	2415m	Co
58. Simaroubaceae								
269	<i>Ailanthus altissima</i> (P. Mill.) Swingle.	T	MiP	Mic	C	Sp	2754m	Co
59. Solanaceae								
270	<i>Solanum nigrum</i> L.	H	Th	Mes	S	Sp	2443m	Co
271	<i>Solanum tuberosum</i> L.	H	G	Mes	S	Su	2516m	Co
60. Tamaricaceae								
272	<i>Tamaricaria elegans</i> (Royle) Qaiser & Ali	S	Np	L	S	Sp	2751m	Co
273	<i>Tamarix dioica</i> Rox.ex Roth.	S	MiP	L	S	Sp	2861m	Co
61. Thymelaeaceae								
274	<i>Daphne mucronata</i> Royle	H	Th	L	S	Sp	2722m	R
62. Ulmaceae								
275	<i>Celtis australis</i> L.	H	MeP	Mic	S	Sp	2762m	R
63. Urticaceae								
276	<i>Parietarica lusitanica</i> L.	H	Th	N	S	Sp	2652m	R
64. Verbenaceae								
277	<i>Verbena officinalis</i> L.	H	Th	L	S	Su	2732m	R
65. Violaceae								
278	<i>Viola serpens</i> Wall ex Roxb.	H	G	Mic	S	Sp	3217m	F
66. Vitaceae								
279	<i>Vitis vinifera</i> L.	S	NP	Mag	C	Sp	2732m	Co
67. Zygophyllaceae								
280	<i>Peganum harmala</i> L.	H	H	N	S	Sp	2953m	Co

Key: Serial Number, 1: Habit, 2: Life form, 3: Leaf size, 4: Leaf lamina type, 5: Flowering period, 6: Altitude, 7: Occurrence, H: Herb, S: Shrub, T: Tree, Th: Therophytes, G: Geophytes, Ch: Chamaephytes, He: Hemicryptophytes, MaP: Megaphanarophytes, MiP: Microphanarophytes, MeP: Mesophanarophytes, NP: Nanophanarophytes, Mac: Magaphylls, Mic: Microphylls, Mes: Mesophylls, N: Nanophylls, L: Leptophylls, S: Simple, C: Compound, I: Insized, A: Aphylus, Su: Summer, Sp: Spring, Co: Common, F: Frequent, R: Rare, Inf: Infrequent, E: Endemic.

Table-2: Summary of characteristics of flora of Zaini Pass, District Chitral

S#	Parameters	Nos.	% age	S#	Parameters	Nos.	% age
Flora							
1.	Total species	280	-	Leaf size			
2.	Family	67	-	1.	Aphyllous	4	1.43%
3.	Genera	195	-	2.	Leptophylls	45	16.18%
Flowering				3.	Nanophylls	95	34.17%
1.	Spring	154	55%	4.	Microphylls	62	22.30%
2.	Summer	113	40.35%	5.	Mesophylls	51	18.34%
3.	Autumn	-	-	6.	Macrophylls	21	7.55%
4.	Winter	-	-	Life form			
5.	Both summer & spring	13	4.65%	1.	Therophytes	112	40.28%
Occurrence				2.	Geophytes	39	14.02%
1.	Common	145	51.78%	3.	Hemi-cryptophytes	43	15.46%
2.	Frequent	8	2.85%	4.	Chamaephytes	36	12.94%
3.	Infrequent	59	21.07%	5.	Climbers	3	1.07%
4.	Rare	58	21.71%	6.	Nano-phanarophytes	11	3.95%
5.	Endemic	10	3.57%	7.	Micro-phanarophytes	6	2.15%
Lamina shape				8.	Meso-phanarophytes	19	6.83%
1.	Aphyllous	4	1.44%	9.	Mega-phanarophytes	7	2.51%
2.	Simple	188	67.87%	10.	Parasites	2	0.71%
3.	Incised	30	10.83%	Divisions			
4.	Compound	55	19.85%	1.	Pteridophytes	3	1.07%
Habits				2.	Gymnosperms	2	0.71%
1.	Herbs	237	84.23%	3.	Angiosperm Monocots	31	12%
2.	Shrubs	19	7.30%	4.	Angiosperm Dicots	244	87%
3.	Trees	24	8.46%				

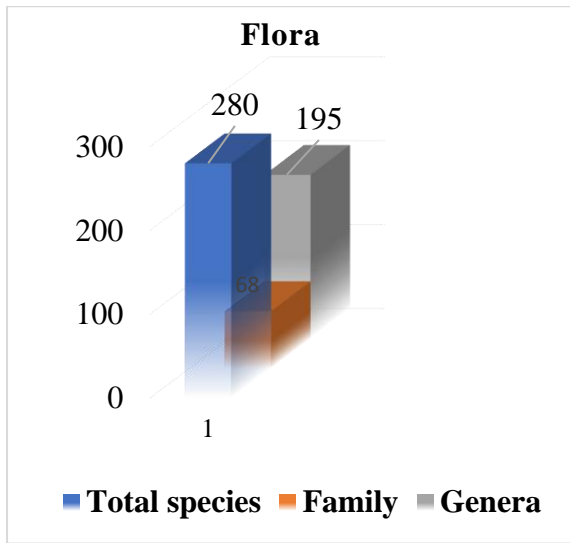


Fig. 1: Graphical representation of flora

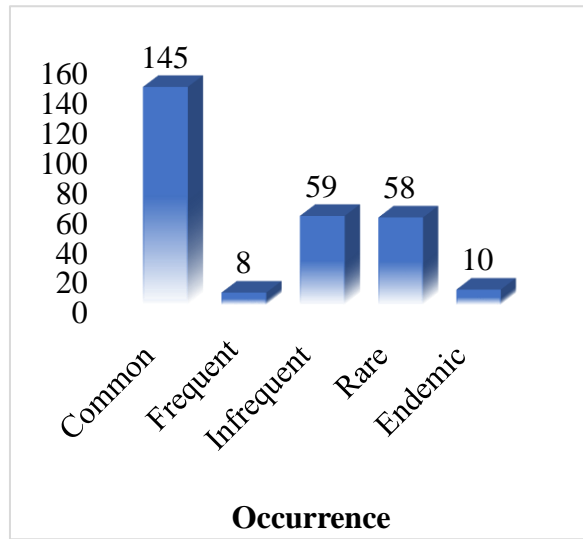


Fig. 2. Species occurrence representation

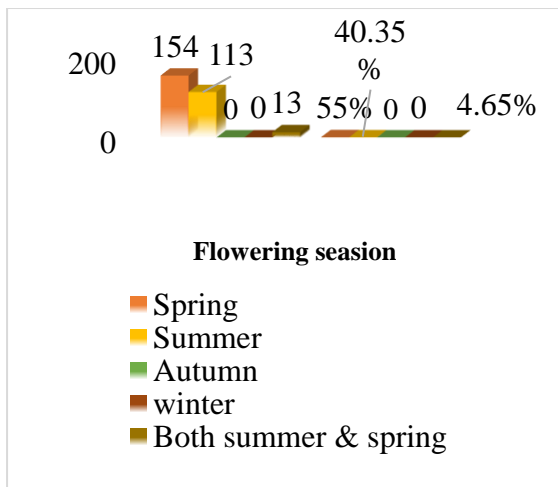


Fig. 3. Representation of flowering seasons

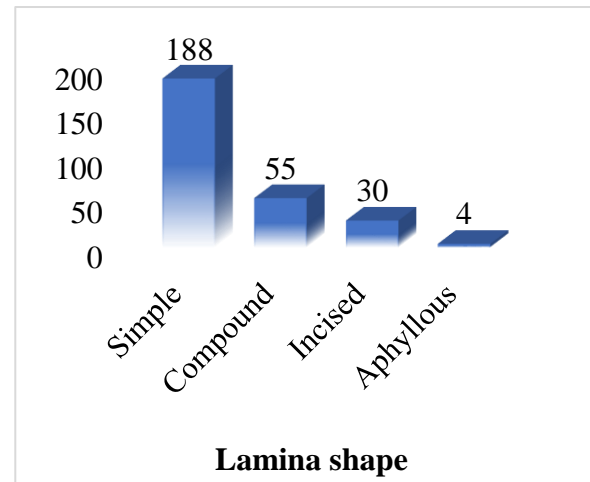


Fig 4. Representation of lamina shape

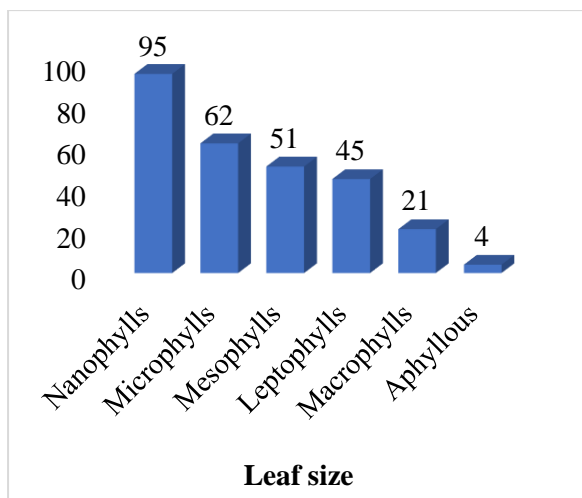


Fig. 5. Representation of leaf size

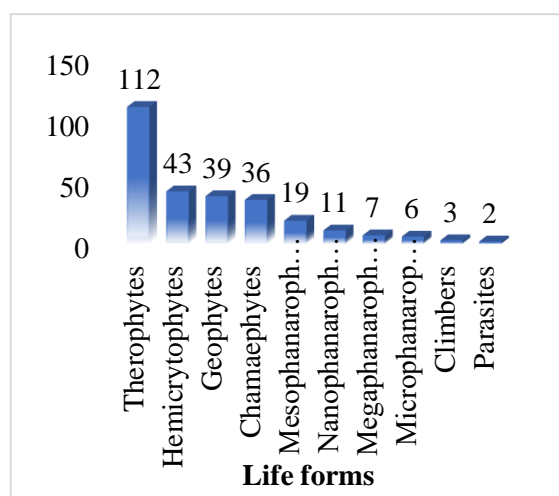


Fig. 6. Representation of Life form

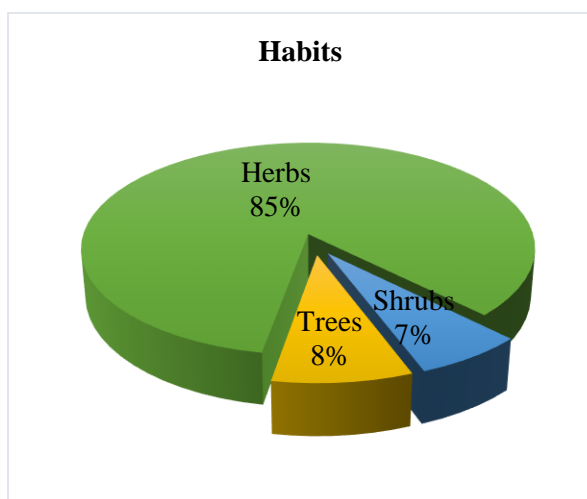


Fig. 7. Representation of Habit

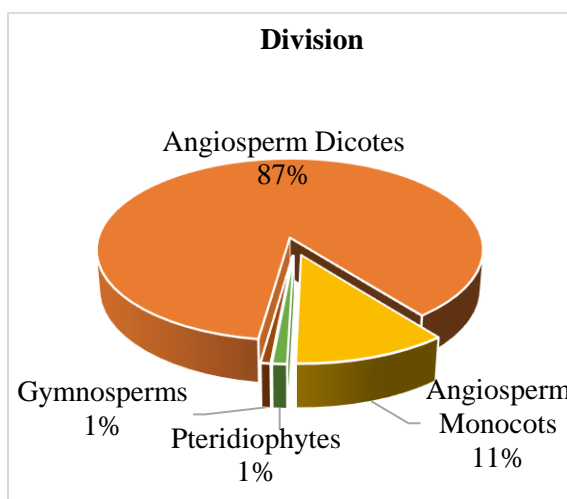


Fig. 8. Representation of plant groups

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