Floristic Composition and Biological Spectrum of Vegetation of Khwazakhela, Swat, Pakistan

Khaista Rahman[1*] https://orcid.org/0000-0002-3692-3523, Shah Zaman[2*] Naveed Akhtar[1], Tahir Hameed[1], Sohail[3]

[1]Department of Botany, Islamia College Peshawar, Pakistan

[2]Department of Botany, University of Malakand, Pakistan

[3]Institute for Biology/Plant Physiology, Humboldt University Zu Berlin, Germany

Abstract

The present study explores the floristic list, life form and leaf size spectra of flora of Khwazakhela Swat, Pakistan. The area home to 63 plants species belong to 58 genera and 38 families in which Asteraceae (12.69%, 8 species) was the leading dominant family followed by Lamiaceae (11.11%, 7 species), Papilionaceae and Rosaceae (4.76% 3 species) for each. Four families contributed 2 species for each to the floristic list of the area while the other 26 families were monspecific. Therophyte (23 species, 36.51%) were dominant followed by nanophanerophytes (13 species, 20.63%) and chamaephytes (8 species, 12.70 %). In the assessment of leaf form spectra the dominant leaf form was nanophylls (20 species, 31.75%) followed by microphylls (17 species, 26.98%), mesophylls (15 species, 23.81%) and leptophylls (7 species, 11.11%).

Key words: Floristic list, Life form, Leaf Size Spectra, Khwazakhela, Swat, Pakistan.

1. Introduction

Khwazakhela is the administrative subdivision of District Swat. It is situated in South East of Mingora at 23 Km distance. It contains seven wards and further sub wards and union councils. The area has a variable type of climatic condition and is very cold in winter and pleasant in summer season. The vegetation of the study area is diverse and home to several medicinally and ecologically important plants species (Rahman *et al.,* 2016). Floristic checklist of an area is a source for the collection of botanical information and provide a useful way for the detailed study

(Keith, 1988) It provides an important public outreach and fundamental information to use in addressing the biodiversity crisis (Funk *et al*., 2007). Biological spectrum (life form and leaf size spectra) are the most important characteristics widely used for the study of vegetation. Life form of plants species of an area determined the macroclimatic and microclimatic conditions of an area (Shimwell, 1971) while the determination of leaf size classes are helpful for the understanding of physiological processes of plants species and their respective communities (Oosting, 1956). A lot of work has been published on floristic list and ecological characteristics of different location in Pakistan as well as abroad such as Keith (1988) Batalha & Martins (2002), Kar *et al.*, (2010), Al-Yemeni & Sher (2010), Amjad *et al*. (2012), Badshah *et al.* (2013), Badshah *et al.* (2010). Musharaf *et al.* (2011). Alsherif *et al.* (2013), Hussain *et al.* (2015), Qureshi *et al.* (2011) Rahman *et al.* (2016) and Hameed *et al.* 2020. However there are not found any information on the flora of Khwazakhela, therefore the present study aims to explore the floristic list and ecological characteristics of Khwazakhela, Swat, Pakistan.

2. Materials and Methods

The present research was conducted during 2015-2016. Regular trips were arranged for the collection of data and preparation of floristic checklist of plants species. The collected specimens of plants species were dried and mounted on herbarium sheets and identified with the help of flora of Pakistan (Nasir & Ali, 1971-2007; Ali & Qasir, 2010). Raunkiaer (1934) was followed for the determination of Biological spectrum of vegetation. The plants species were classified into various life form and leaf size classes using the following formulas.

$$\text{Life form Spectra} = \frac{\text{Sum of species found in a life form class}}{\text{Sum of species in all lifeform classes}} \text{x}100$$

$$\text{Leaf size Spectra} = \frac{\text{Sum of species in a leaf size class}}{\text{Sum of species in all leaf size classes}} \text{x}100$$

Seasonal variation in life form and leaf form was also calculated using the percentage of each life form and leaf form classes.

3. Results and Discussion

I. Floristic Composition

Floristic list of the study area is comprised of 63 species belong to 58 genera and 38 families. Asteraceae (12.69%, 8 species) was found to be the leading dominant family followed by Lamiaceae (11.11%, 7 species), Papilionaceae and Rosaceae (4.76%, 3 species) for each. Four families contributed 2 species for each to the floristic list of the area. The other 26 monspecific families shared 48% species with the floristic list of the area (Fig.1, Table 1). Hussain *et al.* (2004) and reported 256 species belonging to 90 families from different parts of Swat. Sher *et al.* (2014) explored the flora of Gadoon Hills (Swabi) and reported 260 species belong to 90 families and 211 genera. They also reported Asteraceae and Poaceae the dominant families in the area. Durrani *et al.* (2005) reported 202 plants species belonging to 45 families from Kalat, (Pakistan) and found Asteraceae, Papilionaceae and Poaceae the richest families. Sher & Khan (2007) found Asteraceae as the richest family with 21 species followed by Papilionaceae (12 species) and Lamiaceae (10 species) from Chagharzai Valley (Buner). Durrani *et al.* (2010) reported Asteraceae, Fabaceae and Poaceae the richest families in the protected area of Aghberg rangelands (Quetta) Pakistan. Shah & Hussain (2008) reported 51 plants species belong to 35 families from Akbarpura District Nowshera (Pakistan) and found Poaceae as the dominant family followed by Asteraceae and Euphorbiaceae. Qureshi *et al.* (2014) recorded the flora of Khanpur Dam and found 221 species belong to 169 genera and 66 families in which Poaceae and Asteraceae were reported dominant families in term of number of species. The present findings are an agreement with the above authors but difference in the number of species and families may be due to difference in micro climatic condition as well as size of the area as scientist mostly selected large area for the exploration of flora. In the present findings the Asteraceae and Lamiaceae are reported dominant families by others which indicating the wide ecological amplitude of their species.

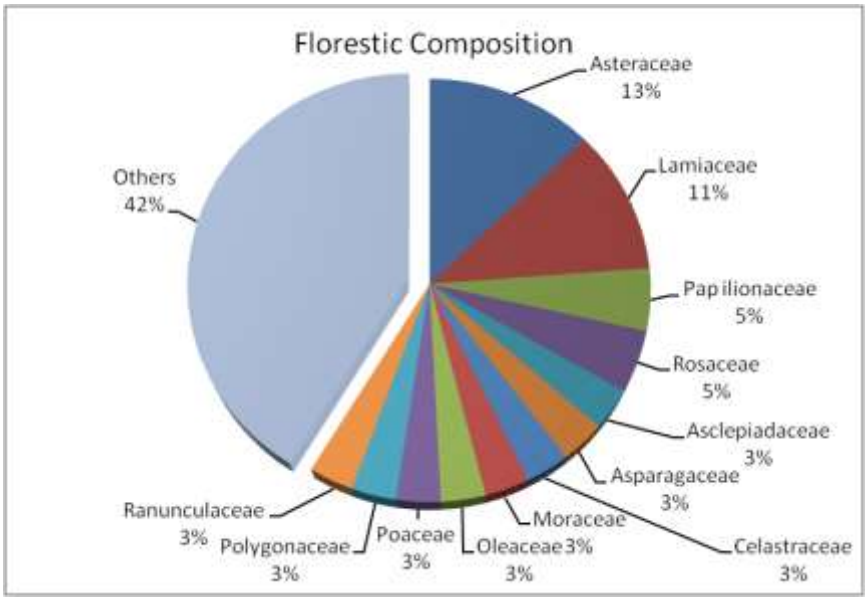

Fig 1. Floristic composition of vegetation of Khwazakhela, Swat, Pakistan

Table 1: Floristic list, Life form and Leaf size of plants and seasonality of plants species of Khwazakhela, Swat, Pakistan

S.no	Species	Family	Life Form	Seasonality				Leaf Size Spectra
				Spring	Summe	Autum	Winter	
1	*Achyranthes bidentata* Blume	Amaranthaceae	Th	+	+			N
2	*Cotinus coggyria* Scop.	Anacardiaceae	Mesp	+	+	+	+	Mes
3	*Pimpinella stewartii* Dunn. Nasir.	Apiaceae	Th	+	+			N
4	*Hedera nepalensis* K. Koch	Araliaceae	Np	+	+	+	+	Mes
5	*Calotropis procera* (Wild) R.Br.	Asclepiadaceae	Ch	+	+	+	+	Mes
6	*Cynanchum arnottianum* Wight.		Ch	+	+	+	+	Mes
7	*Asparagus gracilis* Royle ex Baker.		G	+	+	+	+	L
8	*Asparagus officinalis* L.	Asparagaceae	Ch	+	+	+	+	L

9	*Artemisia scoparia* Wildest. & Kit.	Asteraceae	Th	+	+	+		N
10	*Calendula arvensis* L.		Th	+				Mic
11	*Carbenia benedicta* (L) Benth. Hk		Th	+	+			N
12	*Cirsium arvense* (L.) Scop.		Th	+	+			Mac
13	*Inula grandiflora* Willd.		Th	+	+			Mes
14	*Parthenium hysterophorus* L.		H		+			L
15	*Tagetes minuta* L.		Th		+	+	+	N
16	*Taraxacum officinale* Web.		Th	+	+			Mic
17	*Berberis lyceum* Royle.	Berberidaceae	Np	+	+	+	+	Mic
18	*Alnus nitida* Endl.	Betulaceae	Mesp	+	+	+	+	Mes
19	*Cannabis sativa* L.	Cannabaceae	Th	+	+	+		Mic
20	*Maytenus royleanus* (Wall. ex Lawson)	Celastraceae	Np	+	+	+	+	MIC
21	*Maytenus wallichiana* (Spreng. ex Wight & Arn.) Raju & Babu		Megp	+	+	+	+	MIC
22	*Chenopodium botrys* L	Chenopodiaceae	Th		+	+		Mic
23	*Echinops echinatus* Roxb.	Euphorbiaceae	Th		+			Mic
24	*Quercus baloot* Griff.	Fagaceae	Mesp	+	+	+	+	Mic
25	*Hypericum patulum* Thunb.	Hypericaceae	Ch				+	N
26	*Ajuga bracteosa* Wall. ex Benth.	Lmiaceae	H	+	+	+		Mic
27	*Ajuga parviflora* Benth.		TH	+	+			Mes
28	*Isodon rugosus* Wall. ex Benth.		Np	+	+	+	+	Mes
29	*Mentha longifolia* L.		H	+	+	+		N
30	*Mentha spicata* L.		G	+	+			N
31	*Micromeria biflora* (Ham.) Benth.		Ch	+	+	+		L
32	*Salvia moorcroftiana* Wall. ex Benth.		Th	+	+	+		Mac
33	*Acacia modesta* Wall	Mimosaceae	Microp	+	+	+	+	L

34	*Ficus carica* L.	Moraceae	Megp	+	+	+	+	Mes
35	*Morus alba* L.		Megp	+	+	+	+	Mes
36	*Myrsine africana* L.	Myrsinaceae	NP	+	+	+	+	N
37	*Jasminum humile* L.	Oleaceae	Mi	+	+	+	+	NP
38	*Olea ferruginea* Royle		Mesp	+	+	+	+	Mic
39	*Oxalis corniculata* L.	Oxalidaceae	Th	+	+	+		N
40	*Medicago sativa* L	Papilionaceae	Th	+	+	+		N
41	*Astragalus graveolens* Buch.-Ham.		Ch	+	+	+		L
42	*Vicia sativa* L.		TH	+			+	N
43	*Pinus roxburghii* Sargent.	Pinaceae	Mesp	+	+	+	+	L
44	*Plantago major* L.	Plantaginaceae	Th		+	+		Mes
45	*Avena sativa* L.	Poaceae	Th	+	+	+		N
46	*coix lacryma* L.		Th	+	+	+		N
47	*Rumex dentatus* L.	Polygonaceae	Ch		+	+		Mes
48	*Rumex hastatus* D. Don		Ch		+	+	+	N
49	*Androsace baltistanica* Y. Nasir	Primulaceae	Hem		+	+		N
50	*Clematis connate*	Ranunculaceae	Np	+	+	+	+	Mes
51	*Delphinium vestitum* Wall. ex Royle		Th	+	+			Mac
52	*Fragaria vesca* L.	Rosaceae	H	+	+			Mic
53	*Rubus fruticosus* L.		Np	+	+	+	+	Mes
54	*Rubus sanctus Schreber*		Np	+	+			MIC
55	*Zanthoxylum armatum* DC.	Rutaceae	NP	+	+	+	+	Mic
56	*Dodonaea viscosa* (L.) Jacq.	Sapindaceae	Np	+	+	+	+	N
57	*Verbascum thapsus* L.	Scrophulariaceae	Th	+	+			Meg
58	*Ailanthus altissima* (Mill) Swingle	simaroubaceae	Megp	+	+	+	+	Mic
59	*Daphne papyracea* Wall, ex steud.	Thymeleaeceae	Np	+	+	+	+	N

60	*Daphne mucronata* Royle.		Np	+	+	+	+	N
61	*Celtis australis* L.	Ulmaceae	Mesp	+	+	+	+	Mic
62	*Debregeasia salicifolia* (D. Don) Rendle	Urticaceae	Np	+	+	+	+	Mes
63	*Verbena officinalis* L.	Verbenaceae	Th	+	+	+	+	Mic

II. Biological Spectrum of Vegetation

Biological spectrum of vegetation is an indicator of the climatic condition and anthropogenic disturbance of a particular area (Durrani *et al.,* 2010). Life-forms have close relationships with environment and can be viewed as strategies for obtaining resources (Cody, 1986). Biological spectrum of vegetation is also helpful for the determination of tolerance range and ecological amplitude of the species (Cain & Castro, 1959). In the present finding the results explains that therophyte (23 species, 36.51%) was the most abundant class followed by nanophanerophytes (13 species, 20.63%), chamaephytes (8 species, 12.70 %), mesophanerophytes (6 species, 9.52%), hemicryptophytes (5 species, 7.94 %) and Megaphanerophytes (4 species, 6.35 %) while Geophytes and microphanerophytes were represented by less number of species (2 species, 3.17 % for each) in the area (Table 2, Fig. 2). The results of leaf size spectra of vegetation showed that plants with nanophylls leaves (20 species, 31.75%) were abundant followed by microphylls (17 species, 26.98%), mesophylls (15 species, 23.81%), leptophylls (7 species, 11.11%) while macrophylls were only represented by 3 species (4.76%). There was found only one megaphylls (1.59%) species (Table 2, Fig. 3). Cain & Castro (1959) and Tareen & Qadir (1993) stated that microphylls are usually characteristic of steppes areas while nanophylls and leptophylls are characteristic of hot deserts climate. Our finding are in deviation from the above statement, the reason may be the anthropogenic disturbance (Hameed *et al.,* 2020) which greatly disturbed the natural phenomenon. Samreen *et al*. (2016) reported nanophylls the dominant leaf form followed by leptophylls, microphylls, mesophylls and macrophylls. The difference in the percentage contribution of life form and leaf form in different areas indicate difference in climatic condition and biotic pressure on vegetation while similarity shows that the environmental condition of the areas are similar which supporting the same composition of percentage values in life form and leaf spectra (Hameed *et al.,* 2020). Archibold (1995) stated that therophytes occur abundantly in

desert areas while more or less high occurrence of this life form indicates some anthropogenic and over-grazing effects in the study areas (Hameed *et al.*, 203; Grime, 2001; Naqinezhad *et al*., 2006). The results indicated that the present area is under severe biotic pressure due to which tress and other shrubs species are cleared and therophyte has dominated the area. As due to increase in human population, forests cutting for fuels agricultural practices, heavy grazing (Rahman *et al.,* 2023) greatly disturbed the environmental condition as well as disturbed the natural habitat of different species. It also causes a shift in the climate of the area. similar study was conducted by Sher *et al.* (2014) and found therophytes and megaphanerophytes the dominant life forms classes followed by nanophanerophytes, while exploring the leaf size spectra they found that microphylls were dominant followed by leptophylls in Swabi (Pakistan) and argued that therophytes and microphylls are the indicators of heavy anthropogenic disturbance such as over grazing and deforestation in the area. Khan, *et al.* (2011) and Hussain, *et al.* (1997) and Ali *et al*. (2016) reported that the dominance of therophytes in the study area indicate heavy biotic pressure accelerated deforestation rate and over grazing (Hameed *et al.,* 2020). Our results are also supported by Sultan-Ud-Din *et al.* (2016) who found therophytes dominant in Shangla (Pakistan).

Table 2: Life form and Leaf size spectra of the flora of Khwazakhela, Swat, Pakistan

Life form Classes	Species				
	Number	%age	Leaf size spectra	Number	%age
Chamaephytes	8	12.70	Leptophyll	7	11.11
Geophytes	2	3.17	Macrophyll	3	4.76
Hemicryptophytes	5	7.94	Megaphyll	1	1.59
Megaphanerophytes	4	6.35	Mesophyll	15	23.81
Mesophanerophytes	6	9.52	Microphyll	17	26.98
Microphanerophyte	2	3.17	Nanophyll	20	31.75
Nanophanerophyte	13	20.63	--		
Therophytes	23	36.51	--		

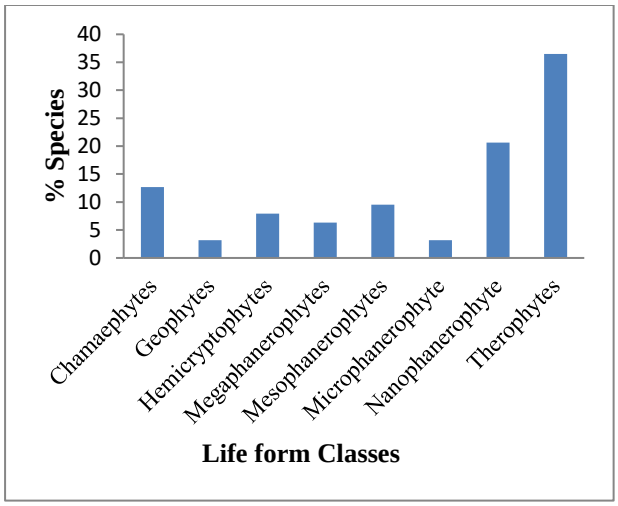

Fig. 2: Life form spectra of vegetation

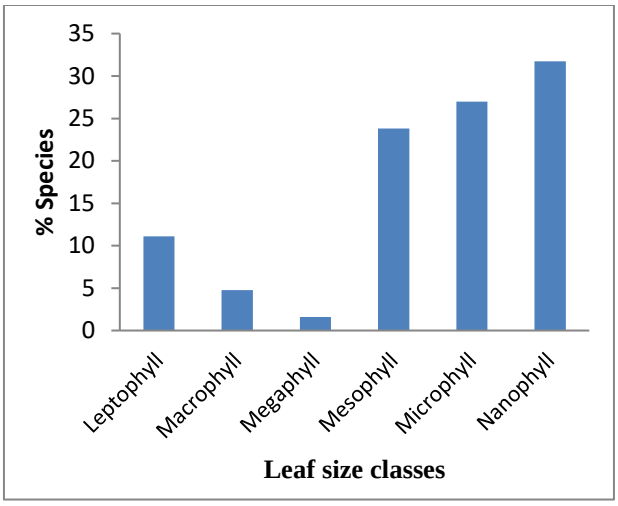

Fig.3: Leaf size spectra of vegetation

III. Seasonal Variation in Biological Spectrum

Seasonal variation in life form in the study area is represented in table (3) and Fig. (4). The results revealed that maximum species were found in summer season followed by spring and autumn while less numbers of species were found in winter season. The seasonal variations in life form showed that in spring therophytes (19 species, 34.55 %) were dominant followed by nanophanerophyte (13 species, 23.64 %). Similar to spring, the summer season was also dominated by therophytes (21 species, 35%) followed by nanophanerophyte (13 species, 21.67 %). Both of these life form classes showed equal pattern of dominancy in autumn season (Table 3, Fig. 4) while in winter nanophanerophytes were dominant followed by mesophanerophytes and chamaephytes (6 species for each). Seasonal variation in life form occurs due to annual species which completing their life cycle in a short period of time. Seasonal variation in life form is also reported by Al-yameni & Sher (2010) from Asir Mountains, Saudi Arabia. Ali *et al*. (2016), reported seasonal variation in life form from Chail valley (Swat), and found therophytes dominant in spring, summer and nanophanerophytes during autumn and winter season. The seasonal variation in life form was also reported by Samreen *et al*. (2016).

The results of seasonal variation in leaf form revealed that in spring season, nanophylls (17 species, 30.91 %) were dominant followed by microphylls (15 species, 27.27%), mesophylls (13 species, 23.64 %), leptophylls (6 species, 10.91%), macrophylls and megaphylls. Same pattern of dominancy in leaf form was found in summer season while difference was found in percentage

contribution of species. Nanophylls (15 species, 31.91%) were also found dominant in autumn season followed by mesophylls, leptophylls and macrophylls while, there was not found any megaphylls species. in winter season. Mesophylls (11 species, 33.33 %) were found abundance followed by microphylls and nanophylls (Table 4, Fig.5). The percentage of different leaf form classes varied with change in altitude Saxena *et al*. (1987). Dolph & Dilcher (1980) reported megaphylls as a dominant leaf form. Amjad *et al*. (2012) stated that the dominancy of microphylls are the characteristic features of cold, dry climate and degraded habitat however leaves alone could not recognize a definite climate of an area without the combination of other morphological and anatomical features which provide more perfect results to establish a climate.

Table 3: Seasonal variation in Life form in Khwazakhela, Swat, Pakistan

Life form Classes	Spring	Summer	Autumn	Winter
	Species	Species	Species	Species
Chamaephyte	6	7	7	6
Geophyte	2	2	1	1
Hemicryptophyte	3	5	3	0
Megaphanerophyte	4	4	4	4
Mesophanerophyte	6	6	6	6
Microphanerophyte	2	2	2	2
Nanophanerophyte	13	13	12	12
Therophytes	19	21	12	3
Sum	55	60	47	34

Table 4: Seasonal variation in leaf size spectra in Khwazakhela, Swat, Pakistan

Leaf size spectra Leaf type	Spring	Summer	Autumn	Winter
	Species	Species	Species	Species
Leptophyll	6	7	6	4
Macrophyll	3	3	1	1
Megaphyll	1	1	0	0
Mesophyll	13	15	13	11

Microphyll	15	16	12	9
Nanophyll	17	18	15	9
Sum	55	60	47	34

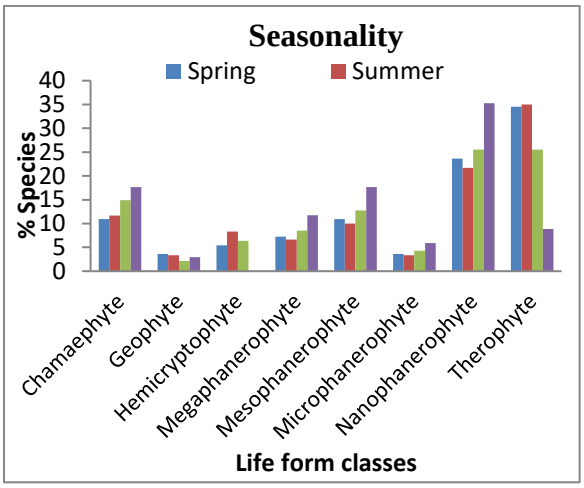

Fig. 4: Seasonal variation in Life form spectra

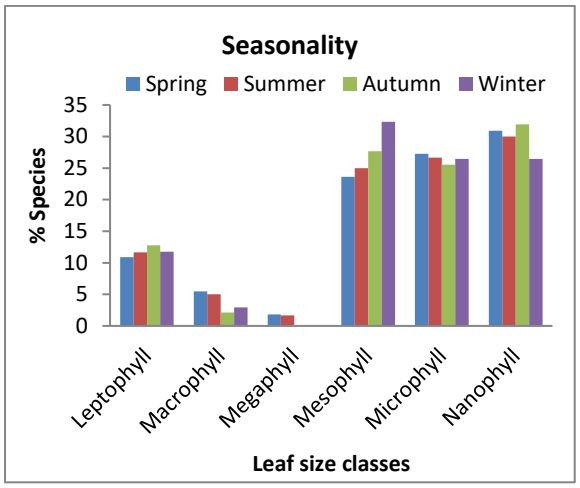

Fig. 5: Seasonal variation in Leaf size spectra

IV. Conclusion

From the above study it is concluded that the Phyto-climate of the area is therophytic type which indicates that the flora of the area is under heavy biotic pressure (Over grazing, collection of plants for different purposes) which results in the disturbance of natural biological spectrum of vegetation in the area.

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