



Ecological evaluation and phytodiversity of vascular plants in Mir Ali, North Waziristan, Pakistan

Asif Raza*, Syed Mukaram Shah

Centre of Plant Biodiversity, University of Peshawar, Pakistan

Key words: Floristic diversity, Biological spectra, Phenology, Vascular plants, Mir Ali, North Waziristan.

<http://dx.doi.org/10.12692/ijb/16.1.205-226>

Article published on January 15, 2020

Abstract

Ecological research was conducted during 2016-2019, to assess the floristic diversity and biological spectra of vascular plant species in Mir Ali Subdivision, North Waziristan, Pakistan. The floristic list consisted of 336 plant species belonging to 229 genera and 79 families. There were 269 dicots, 60 monocots, 4 gymnosperms and 3 pteridophyte species. Poaceae (44 Spp., 13.09 %) and Asteraceae (28 Spp., 8.33 %) were leading families. Life form classes was dominated by Therophytes (171spps. 50.9%) followed by Nanophanerophytes (43 spps., 12.79%) and Megaphaneropyhtes (37 spps., 11.01%). Leaf size spectrum showed that leading leaf size classes were Nanophylls with 139 (41.4%) species, Microphylls 65(19.34%) species and Leptophylls consisted of 52 (15.5%) species. There were 313 (93.15%) deciduous species, 20 (5.95%) evergreen species and 3 (0.9%) aphyllous plant species. There were 283 (84.22%) non spiny plants and 53 (15.78%) spiny plant species. 276 (82.14%) species lived in terrestrial habitat and 60 (17.86%) dwelled in mesic habitat. The light requirements showed that 332 (98.8%) species found in light condition while 4 (1.2%) grow in shady places. 243 (72.32%) plants grow wild and 93 (27.67%) were cultivated plant species. 233 (69.35%) species had simple leaf structure while 52 (15.48%) plants possessed compound leaf structure. The phenology showed that 223 (66.36%) species were found at reproductive (S2), 84 (25%) pre-reproductive (S1) and 29 (8.63%) at post-reproductive (S3) stages. Atmospheric, edaphic and biotic factors effect distribution of plant species. The study concluded that the area has rich plant biodiversity which is subjected to heavy biotic pressures of grazing and deforestation. Conservation measures, sustainable utilization and further research are recommended.

* Corresponding Author: Asif Raza ✉ asifwazir1985@gmail.com

Introduction

Mir Ali is a subdivision in North Waziristan Tribal district (FATA) Pakistan, adjoining District Bannu and falls under Inrano-Turanian Region (Ali and Qaiser, 1986). It is divided into three Tehsils namely, Mir Ali, Spinwam and Shawa. Its lies between $32^{\circ}59'12''$ to $33^{\circ}1'16''$ N Latitude and $70^{\circ}15'24''$ to $70^{\circ}17'21''$ E Longitude with an altitude of 655 m (2152 feet). The area is surrounded by mountains which are connected with Koh-e-Sufaid in the North and Koh-e-Sulaiman in the South. The climate of the area is cold in winter with temperature ranging from 15 °C to 23 °C and hot in summer with temperature varies from 31°C to 42 °C and classified as subtropical. The area is fertile and cultivable which is irrigated by three rivers namely, Tochi, Katu and Kurram rivers. The area receive 45 mm monsoon rainfall (Ali and Qaiser, 1986). The forest cover is weak and the soil is mostly shallow and calcareous. Livestock, fuel wood and medicinal plants collection are generally practiced in the research area.

Floristic diversity and its ecological characteristics depend upon prevailing environment, topography and existing ecosystem types. The various characters of flora such as life form, leaf size, phenology and other morphological features reflect the existing ecological and habitat conditions. A rich floristic diversity means favorable growing conditions. Listing of species is required for ecological plant resource management. Many studies for listing floristic diversity and its ecological behavior have been done at home and overseas, for suitable documentation and maintainable consumption of plants (Rafay *et al.*, 2013). The information about vegetation of any area is important for the learning of biodiversity (Badshah *et al.*, 2010). Biological spectrum suggested by Raunkiaer (1934) is the proportion delivery of diverse life-forms for particular vegetation. It can be used as a key for comparing actually detached plant groups, controls layering and stratification design of a community, nature of phytoclimate and its ambient pressure issues (Gazal and Raina, 2015). The life-form arrangement is a significant physiognomic characteristic that expresses the coordination among

plant and its surroundings (Shimwell, 1971). Leaf size spectrum delivers an awareness of the floristic version and is beneficial for exploring plant relations in relative to the dominant climatic features and thus can help in studying flora at local level (Rashid *et al.*, 2011). Bibi *et al.* (2016) studied the structure and floristic composition of 30 species of road sides and central green belt of Motorway (M-1) from Peshawar to Charsadda Interchange. Shaheen *et al.* (2015) studied 205 plants species which belonged to 78 families with Asteraceae and Lamiaceae as dominant families. Hussain *et al.* (2015) identified 571 species belonging to 82 families while reporting the floristic diversity of Mastuj valley; district Chitral, Hindukush Range, Pakistan. Ullah *et al.* (2015) prepared a checklist of 107 plant species belonged to 90 genera and 49 families of Sheikh Buddin National Park, Dera Ismail Khan, Pakistan. Durrani *et al.* (2010) studied 123 plant species of 36 families from protected sites and 28 species from unprotected sites from Aghberg rangeland, Balochistan. Saima *et al.* (2009) studied 167 plant species of 65 families from Ayubia National Park, District Abbottabad. Badshah *et al.* (2013) studied the floristic diversity and ecological features of vegetation of District Tank. Sher *et al.* (2014) worked on the diversity and ecological structures of vegetation of Gadoon, District Swabi. Khan *et al.* (2017) identified 264 plants species belonging to 90 families and 202 from Swat Ranizai of District Malakand, Pakistan. Ali *et al.* (2017) identified 104 plant species belonged to 46 families and 95 genera in Sherpao, Charsadda, Pakistan. Haq *et al.* (2018) documented 183 plant species from Keran valley of northwestern Himalya in which 37% therophytes were dominant life form. Khan *et al.* (2018) identified 80 plant species belonged to 45 families in Thandiani forest Abbotabbad, Pakistan. Samad *et al.* (2018) identified 80 plant species belonged to 45 families in Lala Kalay, Peshawar, Pakistan in which Asteraceae and Solanaceae were the leading families with 6 species each. Ahmed *et al.* (2019) studied 352 plant species belong to 150 genera and 82 families in which 31.25% were hemicryptophytes dominant life form spectra in the area of Kotli Sattian Kahтта national park Murree, Pakistan. Amber *et al.* (2019) studied

133 plant species of 52 families from Mahnsehra, Pakistan. Anwar *et al.* (2019) studied 195 plant species belong to 63 families from Liakot forest in kalam region of district Swat. therophyte (86 spp.) was dominant life form and nanophyll (73 spp.) was dominant life size class followed by microphyll (66 spp.) and mesophyll (44 spp.). Iqbal *et al.* (2019) identified the floristic composition of 36 grass species belonging to 23 genera of west region of D.G.Khan, Pakistan which help in ecological and biological spectra of research area.

Mir Ali subdivision is botanically less explored. Some references are available on weed flora of rain fed maize fields of Mir Ali (Wazir *et al.*, 2014), flora and

vegetation of gymnosperms of Razmak (Daud *et al.*, 2013) and medicinal plants in North Waziristan (Qaiser *et al.*, 2013). No other reference on the plants of Mir Ali is available. The present effort recorded the diversity and ecological features of plants of Mir Ali subdivision that will help in future researchers.

Materials and methods

Floristic diversity

Plants including cultivated species were collected from Mir Ali subdivision during 2016-2019. They were collected, dried, identified with the help of available literature and flora of Pakistan (Nasir & Ali, 1970-1989., Ali & Nasir, 1989-1991; Ali & Qaiser, 1993-2019).

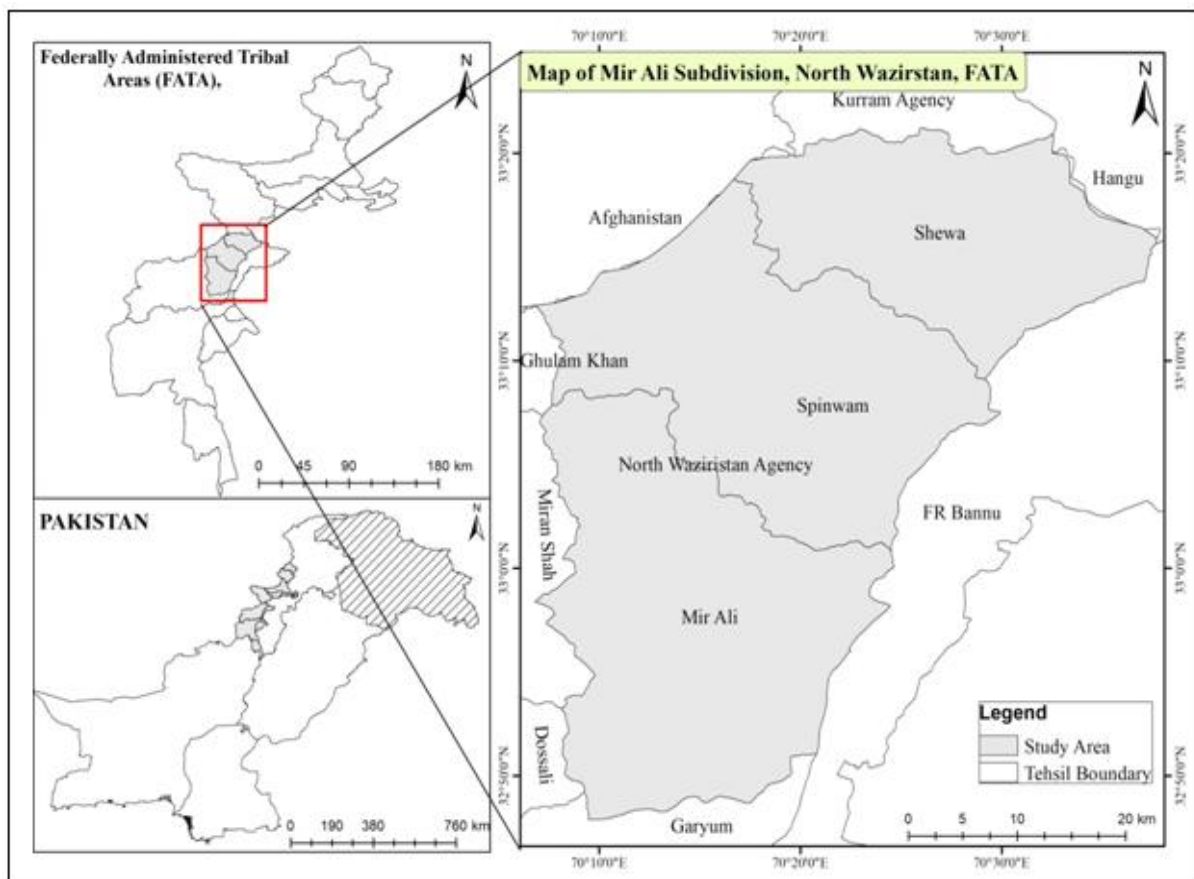


Fig. 1. Map of the research area. (Source: GIS Lab, Geography Department, University of Peshawar).

A complete floristic list was compiled by arranging plants alphabetically within each group, family and genera. Plants were mounted on standard herbarium sheets and the specimens were deposited in Herbarium of Centre of Plant Biodiversity, University of Peshawar.

Ecological characteristics

Leaf persistence, spiny nature, habitat, light requirement, cultivation/wild and leaf shape of species were observed in the field.

Life-form and leaf size spectra

Life-form and leaf size classes were assigned to plants by following Raunkiaer (1934), Hussain (1989) and Hussain *et al.* (2015). Plant species were categorized to life-form classes based on the position of the perennating buds. Raunkiaerian (1934) leaf size diagram was used in the field for rapid calculation. (Fig.2).

Results and discussion

Floristic diversity

In the present study 336 plant species belonging to 229 genera and 79 families were recorded from study area (Table 1 and 2). It included 63 dicots, 11 monocots, 3 gymnosperm and two pteridophytes families. Gymnosperms and pteridophytes had 4 and 2 genera, respectively. There were 178 dicots and 45 monocots genera. Table 1 shows that Poaceae (44 Spp., 13.09 %) and Asteraceae (28 Spp., 8.33 %) were the leading families.

Table 1. Floral diversity and ecological characteristics of Plants in Mir Ali, North Waziristan, Pakistan.

S#	Plant Species	Ecological Characteristics								
		1	2	3	4	5	6	7	8	9
A. PTERIDOPHYTES										
1. Equisetaceae										
01.	<i>Equisetum arvense</i> L.	G	Aph	E	-	Sd	M	W	Abs	S1
2. Pteridaceae										
02.	<i>Adiantum capillus-veneris</i> L.	G	N	E	-	Sd	M	W	Com	S1
03.	<i>Adiantum venustum</i> D. Don	G	N	E	-	Sd	M	W	Com	S1
B. GYMNOSPERMS										
3. Araucariaceae										
04.	<i>Araucaria columnaris</i> (G.Forst.) Hook.	NP	N	E	-	L	D	C	Com	S1
4. Cupressaceae										
05.	<i>Cupressus sempervirens</i> L.	MP	L	E	-	L	D	C	Dis.	S2
06.	<i>Thuja orientalis</i> L.	NP	L	E	-	L	D	C	Dis.	S2
5. Pinaceae										
07.	<i>Pinus roxburghii</i> Sargent.	MP	L	E	-	L	D	C	Com	S1
C. ANGIOSPERMS										
a. MONOCOTYLEDANAE										
6. Agavaceae										
08.	<i>Yucca aloifolia</i> L.	NP	L	E	-	L	D	W	Com	S2
7. Alliaceae										
09.	<i>Allium cepa</i> L.	G	N	Dec	-	L	D	C	S	S1
10.	<i>Allium griffithianum</i> Boiss.	G	N	Dec	-	L	D	W	S	S1
11.	<i>Allium sativum</i> L.	G	N	Dec	-	L	D	C	S	S1
8. Araceae										
12.	<i>Arisaema flavum</i> (Forsk.) Schott.	G	Mic	Dec	-	L	M	W	Com	S2
9. Arecaceae										
13.	<i>Livistona chinensis</i> (Jacq.) R.Br. ex Mart.	NP	Meg	E	-	L	D	C	Com	S1
14.	<i>Nannorrhops ritchiana</i> (Griff.) Aitchison	NP	Meg	E	+	L	D	W	Com	S1
15.	<i>Phoenix dactylifera</i> L.	MP	Mes	E	+	L	D	W	Com	S2
10. Asparagaceae										
16.	<i>Asparagus monophyllus</i> L.	H	L	E	-	L	D	W	Com	S2
11. Cannaceae										
17.	<i>Canna indica</i> L.	G	Meg	E	-	L	D	C	S	S2
12. Cyperaceae										
18.	<i>Cyperus difformis</i> L.	G	N	E	-	L	M	W	S	S2
19.	<i>Cyperus rotundus</i> L.	G	N	E	-	L	M	W	S	S2
13. Iridaceae										
20.	<i>Moraea sisyrinchium</i> (L.) Ker Gawl.	G	Mes	Dec	-	L	D	W	S	S2
14. Juncaceae										

21.	<i>Juncus bufonius</i> L.	G	L	E	-	L	M	W	S	S2
		15.	Poaceae							
22.	<i>Agrostis viridis</i> Gouan.	Th	Mes	Dec	-	L	D	W	S	S2
23.	<i>Apluda mutica</i> L.	H	Mes	Dec	-	L	D	W	S	S2
24.	<i>Alopecurus myosuroides</i> Huds.	Th	Mes	Dec	-	L	D	W	S	S2
25.	<i>Aristida cyanantha</i> Steud.	H	Mic	Dec	-	L	D	W	S	S2
26.	<i>Aristida mutabilis</i> Trin. & Rupr.	H	Mic	Dec	-	L	D	W	S	S2
27.	<i>Arundo donax</i> L.	H	Mac	Dec	-	L	M	W	S	S2
28.	<i>Avena barbata</i> Pott ex Link.	Th	N	Dec	-	L	D	W	S	S2
29.	<i>Bambusa vulgaris</i> Schrad.	NP	N	Dec	-	L	D	C	S	S1
30.	<i>Brachiaria distachya</i> L.	Th	Mic	Dec	-	L	D	W	S	S2
31.	<i>Bromus catharticus</i> Vahl.	Th	N	Dec	-	L	D	W	Dis	S2
32.	<i>Bromus danthoniae</i> Trin.	Th	N	Dec	-	L	D	W	Dis	S2
33.	<i>Bromus tectorum</i> L.	Th	N	Dec	-	L	D	W	Dis	S2
34.	<i>Cenchrus biflorus</i> Roxb.	H	L	Dec	-	L	D	W	S	S2
35.	<i>Cenchrus ciliaris</i> L.	H	L	Dec	-	L	D	W	S	S2
36.	<i>Cenchrus pennisetiformis</i> Steud.	H	Mic	Dec	-	L	D	W	S	S2
37.	<i>Cymbopogon jvarancusa</i> (Jones) Schult.	H	N	Dec	-	L	D	C	S	S2
38.	<i>Cynodon dactylon</i> (L.) Pers.	H	L	Dec	-	L	D	W	S	S3
39.	<i>Dactyloctenium aegyptium</i> (L.) Willd.	Th	Mic	Dec	-	L	D	W	S	S2
40.	<i>Desmostachya bipinnata</i> (L.) Stapf	H	Mic	Dec	-	L	D	W	S	S2
41.	<i>Dichanthium annulatum</i> Forssk.	H	N	Dec	-	L	D	W	S	S2
42.	<i>Digitaria pennata</i> Hochst	Th	N	Dec	-	L	D	W	S	S2
43.	<i>Digitaria sanguinalis</i> (L.) Scop.	Th	N	Dec	-	L	D	W	S	S2
44.	<i>Echinochloa colona</i> (L.) Link	Th	N	Dec	-	L	M	W	S	S2
45.	<i>Echinochloa crus-galli</i> (L.) P.Beauv.	Th	N	Dec	-	L	M	W	S	S2
46.	<i>Eragrostis cilianensis</i> (All.)Janch.	H	N	Dec	-	L	M	W	S	S2
47.	<i>Eragrostis minor</i> Host.	Th	N	Dec	-	L	M	W	S	S2
48.	<i>Hordeum vulgare</i> L.	Th	Mic	Dec	-	L	D	C	S	S2
49.	<i>Imperata cylindrica</i> (L.) Raeusch	H	L	Dec	-	L	D	W	S	S2
50.	<i>Leptochloa panicea</i> (Retz.) Ohwi	Th	N	Dec	-	L	D	W	S	S2
51.	<i>Lolium perenne</i> L.	Th	Mic	Dec	-	L	D	W	S	S2
52.	<i>Oryza sativa</i> L.	Th	Mic	Dec	-	L	M	C	S	S2
53.	<i>Panicum antidotale</i> Retz.	Th	N	Dec	-	L	D	W	S	S2
54.	<i>Phalaris aquatica</i> L.	G	N	Dec	-	L	D	W	S	S1
55.	<i>Phragmites karka</i> (Retz.) Trin. ex Steud.	G	Mes	Dec	-	L	M	W	S	S1
56.	<i>Poa annua</i> L.	Th	L	Dec	-	L	D	W	S	S1
57.	<i>Poa infirma</i> Kunth	Th	Mic	Dec	-	L	D	W	S	S2
58.	<i>Polypogon monspeliensis</i> (L.) Desf.	Th	N	Dec	-	L	M	W	S	S2
59.	<i>Saccharum benghalensis</i> Retz.	H	N	Dec	-	L	D	W	S	S1
60.	<i>Saccharum munja</i> Roxb.	H	Mac	Dec	-	L	D	W	S	S2
61.	<i>Saccharum spontaneum</i> L.	H	Mac	Dec	-	L	D	W	S	S2
62.	<i>Schismus barbatus</i> (L.) Thell.	Th	Meg	Dec	-	L	M	W	S	S2
63.	<i>Setaria verticillata</i> (L.) P. Beauv.	Th	L	Dec	-	L	M	W	S	S2
64.	<i>Triticum aestivum</i> L.	Th	Mic	Dec	-	L	D	C	S	S2
65.	<i>Zea mays</i> L.	Th	Mes	Dec	-	L	D	C	S	S2
		16.	Typhaceae							
66.	<i>Typha latifolia</i> L.	G	Mes	Dec	-	L	M	W	S	S1
67.	<i>Typha minima</i> Funck ex Hoppe	G	Mes	Dec	-	L	M	W	S	S1
		b.	DICOTYLEDONAE							
		17.	Acanthaceae							
68.	<i>Justicia adhatoda</i> L.	NP	Mes	Dec	-	L	M	W	S	S2
		18.	Aizoaceae							
69.	<i>Trianthema portulacastrum</i> Juss. Ex Medic.	Th	N	Dec	-	L	M	W	S	S3

19. Amaranthaceae	
70.	<i>Achyranthes aspera</i> L. Th N Dec + L M W S S ₂
71.	<i>Aerva javanica</i> (Burm.f.) Juss. Ex Schult. Ch L Dec - L D W S S ₂
72.	<i>Aerva lanata</i> (L.) Juss. Ch L Dec - L D W S S ₂
73.	<i>Alternanthera pungens</i> Kunth. Th N Dec + L D W S S ₂
74.	<i>Amaranthus graecizans</i> L. Th Mic Dec - L D W S S ₂
75.	<i>Amaranthus spinosus</i> L. Th N Dec + L D W S S ₂
76.	<i>Amaranthus viridis</i> L. Th N Dec - L D W S S ₂
77.	<i>Digera muricata</i> (L) Mart Th N Dec - L D W S S ₂
20. Anacardiaceae	
78.	<i>Mangifera indica</i> L. MP Mac Dec - L D C S S ₂
21. Apiaceae	
79.	<i>Carum carvi</i> L. Th N Dec - L D W Dis. S ₂
80.	<i>Coriandrum sativum</i> L. Th N Dec - L D C Dis. S ₁
81.	<i>Foeniculum vulgare</i> Mill. Th Mes Dec - L M W Dis. S ₂
82.	<i>Torilis japonica</i> (Houtt.) DC. Th N Dec - L D W Com S ₂
83.	<i>Trachyspermum ammi</i> (L.) Sprague Th L Dec - L D W S S ₁
22. Apocynaceae	
84.	<i>Leptadenia pyrotechnica</i> (Forssk.) Decne. Th N Dec - L D W Dis S ₂
85.	<i>Nerium oleander</i> Mill. NP Mic Dec - L D W S S ₂
86.	<i>Rhazya stricta</i> Decne. Ch N Dec - L D W S S ₂
87.	<i>Thevetia nerifolia</i> Juss. Ex Steud. NP N Dec - L D W Dis S ₂
23. Asclepiadaceae	
88.	<i>Calotropis procera</i> (Wild.) R.Br. Ch Mes Dec - L D W S S ₁
89.	<i>Caralluma tuberculata</i> N.E.Br. G Mic E + L D W S S ₂
24. Asteraceae	
90.	<i>Artemisia maritima</i> L. H Mic Dec - L D C Dis S ₁
91.	<i>Calendula arvensis</i> M.Bieb. Th N Dec - L D C S S ₂
92.	<i>Carthamus lanatus</i> L. Th Mic Dec + L D W Dis S ₂
93.	<i>Centaurea iberica</i> Trevir. & Spreng. Th N Dec + L D W Dis S ₂
94.	<i>Cichorium intybus</i> L. Th Mac Dec + L D W Dis S ₂
95.	<i>Cirsium arvense</i> (L.) Scop. Th Mic Dec + L D W S S ₂
96.	<i>Cirsium congestum</i> L. Th Mic Dec + L D W S S ₂
97.	<i>Conyza canadensis</i> L. Th Mic Dec - L D W S S ₂
98.	<i>Cousinia minuta</i> Boiss. Th L Dec + L D W S S ₂
99.	<i>Echinops echinatus</i> Roxb. Th Mes Dec + L D W Dis S ₂
100.	<i>Eclipta alba</i> (L.) Hassk. Th N Dec - L M W S S ₁
101.	<i>Helianthus annuus</i> L. Th Mac Dec - L D C Dis S ₂
102.	<i>Lactuca serriola</i> L. Th Mic Dec - L D W S S ₁
103.	<i>Launaea procumbens</i> (Roxb.) Ramayya & Rajagopal Th Mes Dec - L D W S S ₂
104.	<i>Launaea nudicaulis</i> (L.) Hook.f. Th Mes Dec - L D W S S ₂
105.	<i>Lasiopogon muscoides</i> (Desf.) DC. Th N Dec - L D W S S ₂
106.	<i>Parthenium hysterophorus</i> L. Th Mic Dec - L D W S S ₁
107.	<i>Pulicaria dysenterica</i> (L.) Bernh. Th Mic Dec - L D W S S ₁
108.	<i>Reichardia tingitana</i> (L.) Roth Th N Dec - L D W S S ₁
109.	<i>Silybum marianum</i> (L.) Gaertn. Th N Dec + L D W Dis S ₂
110.	<i>Sonchus arvensis</i> L. Th Mes Dec - L M W Dis. S ₂
111.	<i>Sonchus asper</i> (L.) Hill Th Mic Dec - L M W Dis S ₂
112.	<i>Sonchus hierrensis</i> (Pit.) Boulos Th Mic Dec - L M W Dis S ₂
113.	<i>Sonchus oleraceus</i> L. Th Mic Dec - L M W Dis S ₁
114.	<i>Tagetes erecta</i> L. Th N Dec - L D C Dis. S ₂
115.	<i>Taraxacum officinale</i> F.H.Wiggers Th Mic Dec - L M W Dis. S ₂
116.	<i>Verbesina encelioides</i> L. Th N Dec - L D W Dis. S ₁

117.	<i>Xanthium strumarium</i> L.	Th	Mes	Dec	+	L	D	W	S	S1
	25.	Berberidaceae								
118.	<i>Berberis lycium</i> Royle	NP	N	Dec	+	L	D	W	S	S3
	26.	Bignoniaceae								
119.	<i>Jacaranda mimosaeifolia</i> D. Don	Th	Mic	Dec	-	L	D	C	Com	S2
120.	<i>Tecoma stans</i> (L.) Juss. ex Kunth	NP	Mes	Dec	-	L	D	C	S	S1
	27.	Bombacaceae								
121.	<i>Bombax ceiba</i> L.	MP	Mac	Dec	-	L	D	C	S	S2
	28.	Boraginaceae								
122.	<i>Arnebia griffithii</i> Boiss.	Th	L	Dec	-	L	D	W	S	S2
123.	<i>Arnebia hispidissima</i> (Lehm.) A. DC.	Th	L	Dec	-	L	D	W	S	S2
124.	<i>Cordia myxa</i> L.	MP	Mes	Dec	-	L	D	C	S	S2
125.	<i>Cynoglossum lanceolatum</i> Forssk.	Th	Mic	Dec	-	L	D	W	S	S2
126.	<i>Heliotropium ellipticum</i> Ledeb.	Th	N	Dec	-	L	D	W	S	S2
127.	<i>Heliotropium europaeum</i> (F. & M.) Kazmi	Th	Mic	Dec	-	L	D	W	S	S2
128.	<i>Heliotropium ovalifolium</i> Forssk.	Th	Mic	Dec	-	L	D	W	S	S2
129.	<i>Lithospermum arvense</i> L.	Th	N	Dec	-	L	D	W	S	S2
130.	<i>Onosma dichroantha</i> Boiss.	H	N	Dec	-	L	D	W	S	S2
131.	<i>Onosma hispida</i> Wall. ex G. Don	H	N	Dec	-	L	D	W	S	S2
	29.	Brassicaceae								
132.	<i>Brassica napus</i> L.	Th	N	Dec	-	L	D	C	Dis.	S1
133.	<i>Brassica campestris</i> L.	Th	N	Dec	-	L	D	C	Dis.	S1
134.	<i>Brassica rapa</i> L.	Th	N	Dec	-	L	D	C	S	S1
135.	<i>Brassica tournefortii</i> Gouan	Th	N	Dec	-	L	D	C	S	S1
136.	<i>Capsella bursa-pastoris</i> (L.) Medik.	Th	Mac	Dec	-	L	D	C	Dis.	S2
137.	<i>Cardamine hirsuta</i> L.	Th	Mes	Dec	-	L	M	W	Dis.	S2
138.	<i>Chorispora tenella</i> (Pall.) DC.	Th	Mic	Dec	-	L	D	W	S	S2
139.	<i>Coronopus didymus</i> (Linn.) Smith	Th	Mic	Dec	-	L	M	W	Dis.	S2
140.	<i>Eruca sativa</i> Mill.	Th	N	Dec	-	L	D	C	Dis.	S2
141.	<i>Farsetia heliophila</i> Bunge ex Coss.	Th	N	Dec	-	L	D	W	S	S1
142.	<i>Lepidium draba</i> L.	Th	N	Dec	-	L	D	W	S	S2
143.	<i>Lepidium perfoliatum</i> L.	Th	Mic	Dec	-	L	D	W	S	S2
144.	<i>Lepidium sativum</i> L.	Th	N	Dec	-	L	D	W	Dis.	S2
145.	<i>Lepidium virginicum</i> L.	Th	Mic	Dec	-	L	D	W	Dis.	S2
146.	<i>Malcolmia africana</i> (L.) R.Br.	Th	N	Dec	+	L	D	W	S	S2
147.	<i>Malcolmia cabulica</i> (Boiss.) Hook. f. & Thomson	Th	L	Dec	+	L	D	W	S	S2
148.	<i>Raphanus sativus</i> Linn.	Th	Mes	Dec	-	L	M	C	Dis.	S1
149.	<i>Sisymbrium irio</i> L.	Th	Mic	Dec	-	L	D	W	Dis.	S2
150.	<i>Thlaspi andersonii</i> (Hook. f. & Thorns.) O.E. Schulz	Th	Mic	Dec	-	L	M	W	Dis.	S2
	30.	Cactaceae								
151.	<i>Opuntia stricta</i> (Haw.) Haw	Ch	L	Dec	+	L	D	W	Abs	S1
	31.	Caesalpiniaceae								
152.	<i>Bauhinia variegata</i> L.	MP	Mes	Dec	-	L	D	C	S	S1
	32.	Cannabaceae								
153.	<i>Cannabis sativa</i> L.	Th	N	Dec	-	L	D	W	Com	S1
	33.	Capparidaceae								
154.	<i>Capparis decidua</i> (Forssk.) Edgew.	NP	Aph	Dec	+	L	D	W	Abs	S1
155.	<i>Capparis spinosa</i> L.	H	Mes	Dec	+	L	D	W	S	S1
156.	<i>Cleome brachycarpa</i> Vahl ex DC.	Th	N	Dec	-	L	D	W	S	S2
	34.	Caryophyllaceae								
157.	<i>Arenaria griffithii</i> Boiss.	Th	L	E	+	L	D	W	S	S2
158.	<i>Arenaria nevadensis</i> Boiss. & Reuter	Th	L	Dec	-	L	D	W	S	S2
159.	<i>Spergula arvensis</i> L.	Th	N	Dec	-	L	M	W	S	S3
160.	<i>Spergularia marina</i> (L.) Besser	Th	N	Dec	-	L	M	W	S	S3

		35.	Caesalpinaceae							
161.	<i>Cassia senna</i> L.	NP	L	Dec	+	L	D	W	Com	S ₂
162.	<i>Parkinsonia aculeata</i> L.	NP	N	Dec	+	L	D	C	Com	S ₂
		36.	Chenopodiaceae							
163.	<i>Atriplex griffithii</i> Moq.	Ch	N	Dec	-	L	D	W	S	S ₂
164.	<i>Atriplex stocksii</i> Boiss.	Ch	N	Dec	-	L	D	W	S	S ₂
165.	<i>Chenopodium album</i> L.	Th	N	Dec	-	L	D	W	S	S ₁
166.	<i>Chenopodium ambrosioides</i> Linnaeus.	Th	L	Dec	-	L	M	C	S	S ₁
167.	<i>Chenopodium murale</i> L.	Th	L	Dec	-	L	D	W	S	S ₂
168.	<i>Chenopodium nepalense</i> Colla	Th	N	Dec	-	L	D	W	S	S ₂
169.	<i>Chenopodium vulvaria</i> L.	Th	N	Dec	-	L	D	W	S	S ₂
170.	<i>Halostachys belangerana</i> (Moq.) Botsch.	Np	L	Dec	-	L	D	W	S	S ₂
171.	<i>Haloxylon griffithii</i> (Moq.) Boiss.	Ch	L	Dec	-	L	D	W	S	S ₂
172.	<i>Kochia indica</i> Wight.	Th	L	Dec	-	L	D	W	S	S ₁
173.	<i>Spinacia oleracea</i> L.	Th	N	Dec	-	L	M	C	S	S ₂
174.	<i>Suaeda fruticosa</i> Forssk.ex.J.F.Gmelin.	Ch	L	Dec	-	L	D	W	S	S ₁
		37.	Convolvulaceae							
175.	<i>Convolvulus arvensis</i> L.	Th	N	Dec	-	L	D	W	S	S ₂
176.	<i>Convolvulus lineatus</i> L.	Th	N	Dec	-	L	D	W	S	S ₂
177.	<i>Convolvulus prostratus</i> Forssk.	Th	L	Dec	-	L	D	W	S	S ₂
178.	<i>Ipomoea cairica</i> (L.) Sweet	Th	Meg	Dec	-	L	D	C	Dis.	S ₂
179.	<i>Ipomoea eriocarpa</i> R. Br.	Ch	Meg	Dec	-	L	D	W	S	S ₂
		38.	Cucurbitaceae							
180.	<i>Citrullus colocynthis</i> (L.) Schrad.	Th	Mic	Dec	-	L	D	C	Dis.	S ₂
181.	<i>Cucurbita maxima</i> Duchesne.	Th	Mes	Dec	-	L	D	C	Com	S ₁
182.	<i>Luffa acutangula</i> (L.) Roxb.	Ch	N	Dec	-	L	D	C	S	S ₂
183.	<i>Luffa cylindrica</i> (L.) M.Roem.	Ch	N	Dec	-	L	D	C	S	S ₂
		39.	Cuscutaceae							
184.	<i>Cuscuta reflexa</i> Roxb.	P (Cl)	Aph	Ap	-	L	D	W	Dis	S ₃
		40.	Euphorbiaceae							
185.	<i>Chrozophora obliqua</i> sensu Muell. Arg.	H	N	Dec	-	L	D	W	S	S ₂
186.	<i>Chrozophora tinctoria</i> (L.) Raf.	Th	N	Dec	-	L	D	W	S	S ₂
187.	<i>Euphorbia granulata</i> Forssk.	Th	N	Dec	-	L	D	W	S	S ₁
188.	<i>Euphorbia helioscopia</i> L.	Th	N	Dec	-	L	D	W	S	S ₁
189.	<i>Euphorbia hirta</i> L.	Th	N	Dec	-	L	D	W	S	S ₁
190.	<i>Euphorbia hypericifolia</i> L.	Th	N	Dec	-	L	D	W	S	S ₁
191.	<i>Euphorbia prostrata</i> Ait.	Th	N	Dec	-	L	D	W	S	S ₁
192.	<i>Ricinus communis</i> L.	NP	Mac	Dec	-	L	D	W	S	S ₂
		41.	Fumariaceae							
193.	<i>Fumaria indica</i> (Hausskn.) Pugsley	Th	N	Dec	-	L	D	W	Dis	S ₁
		42.	Gentianaceae							
194.	<i>Centaurium pulchellum</i> (Sw.) Druce	Th	L	Dec	-	L	D	W	Dis	S ₂
195.	<i>Centaurium spicatum</i> (L.) Fritsch	Th	N	Dec	-	L	D	W	Dis	S ₂
		43.	Geraniaceae							
196.	<i>Erodium laciniatum</i> (Cay.) Willd.	H	N	Dec	-	L	M	W	S	S ₃
		44.	Hypericaceae							
197.	<i>Hypericum perforatum</i> L.	Ch	N	Dec	-	L	D	W	S	S ₂
		45.	Lamiaceae							
198.	<i>Lycopus europaeus</i> L.	Ch	Mes	Dec	-	L	D	W	S	S ₁
199.	<i>Marrubium vulgare</i> L.	G	Mes	Dec	-	L	D	W	S	S ₁
200.	<i>Mentha longifolia</i> (L.) L.	G	N	Dec	-	L	M	W	S	S ₁
201.	<i>Mentha spicata</i> L.	G	N	Dec	-	L	M	W	S	S ₁
202.	<i>Ocimum basilicum</i> L.	Th	N	Dec	-	L	D	C	S	S ₂
203.	<i>Salvia aegyptiaca</i> L.	Th	L	E	-	L	D	W	S	S ₂

204.	<i>Ziziphora tenuior</i> L.	Th	L	Dec	-	L	D	W	S	S2
46.		Malvaceae								
205.	<i>Abelmoschus esculentus</i> L.	Th	Mes	Dec	-	L	D	C	Com	S1
206.	<i>Hibiscus rosa-sinensis</i> L.	NP	Mic	Dec	-	L	D	C	S	S1
207.	<i>Malva neglecta</i> Wallr.	Th	Mic	Dec	-	L	D	W	S	S2
208.	<i>Malva parviflora</i> L.	Th	Mic	Dec	-	L	D	W	S	S1
209.	<i>Malvastrum coromendelianum</i> (L.) Garcke	H	N	Dec	-	L	D	W	S	S2
47.		Meliaceae								
210.	<i>Azadirachta indica</i> A.Juss.	MP	N	Dec	-	L	D	C	Com	S2
211.	<i>Melia azedarach</i> L.	MP	N	Dec	-	L	D	C	Com	S2
48.		Mimosaceae								
212.	<i>Acacia ampliceps</i> Maslin	Mp	L	Dec	+	L	D	C	Com	S1
213.	<i>Acacia modesta</i> Wall.	Mp	L	Dec	+	L	D	W	Com	S1
214.	<i>Acacia nilotica</i> (L.) Delile	NP	L	Dec	+	L	D	C	Com	S1
215.	<i>Albizia julibrissin</i> Durazz.	MP	N	Dec	-	L	D	C	S	S2
216.	<i>Albizia lebbek</i> (L.) Benth.	MP	N	Dec	-	L	D	C	S	S2
217.	<i>Leucaena leucocephala</i> (Lam.) de Wit	NP	N	Dec	-	L	D	C	S	S2
218.	<i>Prosopis cineraria</i> (L.) Druce	Np	L	Dec	+	L	D	W	Com	S1
219.	<i>Prosopis glandulosa</i> Torr	Np	L	Dec	+	L	D	W	Com	S1
49.		Moraceae								
220.	<i>Broussonetia papyrifera</i> (L.) Vent.	MP	Mes	Dec	-	L	D	C	S	S1
221.	<i>Ficus carica</i> L.	Np	Mes	Dec	-	L	D	W	S	S1
222.	<i>Ficus grossularioides</i> Burm. fil.	Np	Meg	Dec	-	L	D	C	S	S2
223.	<i>Ficus religiosa</i> L.	MP	Mac	Dec	-	L	D	C	S	S2
224.	<i>Morus alba</i> L.	MP	Mes	Dec	-	L	D	C	S	S2
225.	<i>Morus nigra</i> L.	MP	Mes	Dec	-	L	D	C	S	S2
50.		Musaceae								
226.	<i>Musa paradisiaca</i> L.	G	Meg	Dec	-	L	M	C	S	S2
51.		Myrtaceae								
227.	<i>Callistemon lanceolatus</i> (Sm.) Sweet	MP	Mic	Dec	-	L	D	C	S	S2
228.	<i>Eucalyptus camaldulensis</i> Dehnh.	MP	N	Dec	-	L	D	C	S	S1
229.	<i>Eucalyptus torelliana</i> F.Muell.	MP	Mac	Dec	-	L	D	C	S	S1
230.	<i>Psidium guajava</i> L.	NP	N	Dec	-	L	D	C	S	S1
231.	<i>Syzygium cumini</i> (L.) Skeels	NP	N	Dec	-	L	D	C	S	S2
52.		Nyctaginaceae								
232.	<i>Boerhavia diffusa</i> L.	H	N	Dec	+	L	D	C	Com	S3
233.	<i>Bougainvillea alba</i> L.	NP	N	Dec	+	L	D	C	Com	S3
234.	<i>Bougainvillea galabra</i> L.	NP	N	Dec	+	L	D	C	Com	S3
53.		Oleaceae								
235.	<i>Jasminum grandiflorum</i> L.	NP	Mic	Dec	-	L	D	C	S	S3
236.	<i>Jasminum sambac</i> (L.) Aiton	Ch	Mic	Dec	-	L	D	C	S	S3
237.	<i>Olea europaea</i> L.	NP	L	Dec	-	L	D	C	S	S3
238.	<i>Olea ferruginea</i> Wall. ex Aitch.	MP	Mic	Dec	-	L	D	W	S	S3
54.		Oxalidaceae								
239.	<i>Oxalis debilis</i> Kunth	Th	N	Dec	-	L	M	W	Com	S3
240.	<i>Oxalis corniculatus</i> L.	Th	N	Dec	-	L	M	W	Com	S3
55.		Papilionaceae								
241.	<i>Alhagi maurorum</i> Medic.	Th	L	Dec	+	L	D	W	Dis	S2
242.	<i>Astragalus grahamianus</i> Benth.	Ch	L	Dec	+	L	D	W	Com	S2
243.	<i>Astragalus subumbellatus</i> Kl.	Ch	L	Dec	-	L	D	W	Com	S2
244.	<i>Astragalus nivalis</i> Kar. & Kir.	Ch	L	Dec	-	L	D	W	Com	S2
245.	<i>Dalbergia pseudo-sissoo</i> Miq.	MP	N	Dec	-	L	D	W	Com	S2
246.	<i>Indigofera heterantha</i> Brandis	Ch	Mic	Dec	-	L	D	W	Com	S2
247.	<i>Lathyrus aphaca</i> L.	Th	N	Dec	-	L	D	W	S	S2

248.	<i>Lens culinaris</i> Medik	Th	N	Dec	-	L	D	W	Com	S2
249.	<i>Medicago lupulina</i> L.	Th	N	Dec	-	L	D	W	Com	S2
250.	<i>Medicago minima</i> (L.) L.	Th	N	Dec	-	L	D	W	Com	S2
251.	<i>Medicago polymorpha</i> L.	Th	N	Dec	-	L	D	W	Com	S2
252.	<i>Melilotus indica</i> (L.) All.	Th	N	Dec	-	L	D	W	S	S2
253.	<i>Melilotus officinalis</i> (L.) Pall.	Th	N	Dec	-	L	D	W	S	S2
254.	<i>Pisum sativum</i> L.	Th	Mic	Dec	-	L	M	C	S	S2
255.	<i>Taverniera glabra</i> Boiss.	Th	N	Dec	-	L	D	W	Dis	S3
256.	<i>Trifolium alexandrinum</i> L.	G	N	Dec	-	L	M	C	Com	S2
257.	<i>Trifolium repens</i> L.	G	Mic	Dec	-	L	M	W	S	S1
258.	<i>Trifolium semipilosum</i> Fresen.	Th	N	Des	-	L	D	W	Com	S1
259.	<i>Vicia sativa</i> L.	Th (Cl)	N	Dec	-	L	D	W	Com	S2
260.	<i>Vicia tetrasperma</i> (L.) Schreb.	Th (Cl)	N	Dec	-	L	D	W	Com	S2
56.		Plantaginaceae								
261.	<i>Plantago ciliata</i> Desf.	Th	N	Dec	-	L	M	W	S	S2
262.	<i>Plantago lanceolata</i> L.	Th	N	Dec	-	L	D	W	S	S1
263.	<i>Plantago major</i> L.	Th	N	Dec	-	L	M	W	S	S2
264.	<i>Plantago ovata</i> Forssk.	Th	N	Dec	-	L	M	W	S	S2
57.		Platanaceae								
265.	<i>Platanus orientalis</i> L.	MP	Mac	Dec	-	L	D	C	Com	S3
58.		Plumbaginaceae								
266.	<i>Acantholimon lycopodioides</i> (Girard) Boiss.	Ch	L	Dec	+	L	D	W	S	S2
59.		Polygonaceae								
267.	<i>Atraphaxis spinosa</i> L.	Ch	L	Dec	+	L	D	W	S	S2
268.	<i>Calligonum polygonoides</i> L.	NP	L	Dec	-	L	D	W	S	S2
269.	<i>Emex spinosa</i> (L.) Campd.	Th	Mic	Dec	+	L	D	W	S	S2
270.	<i>Fallopia convolvulus</i> L.	Th	L	Dec	-	L	D	W	S	S2
271.	<i>Persicaria maculosa</i> Gray	Th	Mic	E	-	L	M	W	S	S2
272.	<i>Polygonum aviculare</i> L.	Th	L	Dec	-	L	D	W	S	S2
273.	<i>Polygonum barbatum</i> L.	Th	L	Dec	-	L	D	W	S	S2
274.	<i>Polygonum patulum</i> M.Bieb.	G	N	Dec	-	L	D	W	S	S2
275.	<i>Polygonum plebeium</i> R.Br.	Th	N	Dec	-	L	D	W	S	S2
276.	<i>Rumex crispus</i> L.	G	N	Dec	-	L	D	W	S	S1
277.	<i>Rumex dentatus</i> (Mesin.) Rech.f.	G	Mes	Dec	-	L	D	W	S	S2
278.	<i>Rumex hastatus</i> D. Don	G	Mes	Dec	-	L	D	W	S	S2
279.	<i>Rumex hypogaeus</i> T. M. Schust. & Reveal	Th	Mic	Dec	+	L	D	W	S	S2
280.	<i>Rumex vesicarius</i> L.	G	Mic	Dec	-	L	D	W	S	S2
60.		Portulacaceae								
281.	<i>Portulaca oleracea</i> L.	Th	N	Dec	-	L	D	C	S	S1
61.		Primulaceae								
282.	<i>Anagallis arvensis</i> L.	Th	N	Dec	-	L	D	W	S	S2
62.		Punicaceae								
283.	<i>Punica granatum</i> L.	NP	Mes	Dec	-	L	D	C	S	S3
63.		Ranunculaceae								
284.	<i>Ranunculus arvensis</i> L.	G	Mic	Dec	-	L	M	W	Dis.	S2
285.	<i>Ranunculus muricatus</i> L.	G	Mic	Dec	-	L	M	W	Dis.	S2
286.	<i>Ranunculus sceleratus</i> L.	G	Mic	Dec	-	L	M	W	Dis.	S2
64.		Rhamnaceae								
287.	<i>Ziziphus jujuba</i> Mill.	MP	N	Dec	+	L	D	W	S	S2
288.	<i>Ziziphus mauritiana</i> Lam.	Mp	N	Dec	+	L	D	C	S	S2
289.	<i>Ziziphus nummularia</i> (Burm. f.) Wight & Arn.	Np	N	Dec	+	L	D	W	S	S2
65.		Rosaceae								
290.	<i>Eriobotrya japonica</i> (Thunb.) Lindl.	MP	N	Dec	-	L	D	C	S	S2
291.	<i>Malus domestica</i> Borkh.	MP	Mac	Dec	-	L	D	C	S	S2

292.	<i>Prunus armeniaca</i> L.	MP	Mic	Dec	-	L	D	C	S	S ₂
293.	<i>Prunus domestica</i> L.	MP	Mic	Dec	-	L	D	C	S	S ₂
294.	<i>Prunus persica</i> (L.) Batsch	NP	Mic	Dec	-	L	D	C	S	S ₂
295.	<i>Pyrus communis</i> L.	MP	Mac	Dec	-	L	D	C	S	S ₂
296.	<i>Pyrus magyarica</i> Terpc.	MP	Mac	Dec	-	L	D	C	S	S ₂
297.	<i>Rosa alba</i> L.	Ch	Mes	Dec	+	L	D	C	Com	S ₁
298.	<i>Rosa indica</i> L.	Ch	Mes	Dec	+	L	D	C	Com	S ₁
299.	<i>Rosa moschata</i> Herrm.	Ch	Mes	Dec	+	L	D	C	Com	S ₁
66.		Rubiaceae								
300.	<i>Galium aparine</i> L.	Th (Cl)	N	Dec	-	L	D	W	S	S ₃
301.	<i>Galium tricornutum</i> Dandy.	Th (Cl)	N	Dec	-	L	D	W	S	S ₃
67.		Rutaceae								
302.	<i>Citrus aurantium</i> L.	NP	Mes	Dec	+	L	D	C	S	S ₃
303.	<i>Citrus limon</i> (L.) Osbeck	NP	Mic	Dec	+	L	D	C	S	S ₃
68.		Salicaceae								
304.	<i>Populus alba</i> L.	MP	Mes	Dec	-	L	M	C	S	S ₃
305.	<i>Populus ciliata</i> Wall. ex Royle	MP	Mac	Dec	-	L	M	C	S	S ₃
306.	<i>Salix tetrasperma</i> Roxb.	MP	Mes	Dec	-	L	D	C	S	S ₃
69.		Salvadoraceae								
307.	<i>Salvadora oleoides</i> Decne.	Np	N	Dec	-	L	D	W	S	S ₃
70.		Sapindaceae								
308.	<i>Dodonaea viscosa</i> (L.) Jacq.	Np	Mic	Dec	-	L	D	W	S	S ₂
71.		Sapotaceae								
309.	<i>Monothea buxifolia</i> (Falc.) A. DC.	Mp	Mic	Dec	-	L	D	W	S	S ₂
72.		Scrophulariaceae								
310.	<i>Verbascum thapsus</i> L.	G	Meg	Dec	-	L	D	W	S	S ₂
311.	<i>Veronica anagallis-aquatica</i> L.	Th	N	Dec	-	L	D	W	Dis	S ₂
312.	<i>Veronica biloba</i> L.	Th	N	Dec	-	L	D	W	Dis	S ₂
73.		Simaroubaceae								
313.	<i>Ailanthus altissima</i> (Mill.) Swingle	MP	Mes	Dec	-	L	M	W	Com	S ₂
74.		Solanaceae								
314.	<i>Capsicum annuum</i> L.	Th	Mic	Dec	-	L	D	C	S	S ₂
315.	<i>Datura innoxia</i> Mill.	Th	Mes	Dec	+	L	D	W	S	S ₂
316.	<i>Datura stramonium</i> L.	Th	Mes	Dec	+	L	D	W	S	S ₂
317.	<i>Hyoscyamus insanus</i> Stocks.	Th	Mes	Dec	-	L	D	W	S	S ₂
318.	<i>Physalis divaricate</i> D. Don.	Th	Mic	Dec	-	L	D	W	S	S ₁
319.	<i>Lycium barbarum</i> L.	Th	N	Dec	+	L	D	W	S	S ₂
320.	<i>Solanum jacquinii</i> Miq.	Th	Mac	Dec	-	L	M	C	S	S ₂
321.	<i>Solanum lycopersicum</i> L.	Th	Mac	Dec	-	L	D	C	S	S ₂
322.	<i>Solanum nigrum</i> L.	Th	Mes	Dec	-	L	M	W	S	S ₂
323.	<i>Solanum surattense</i> Burm. F.	Th	Mes	Dec	+	L	M	W	S	S ₂
324.	<i>Withania coagulans</i> (Stocks) Dun.	Ch	Mic	Dec	-	L	D	W	S	S ₂
325.	<i>Withania somnifera</i> (L.) Dunal	Ch	Mac	Dec	-	L	D	W	S	S ₂
75.		Tamaricaceae								
326.	<i>Tamarix aphylla</i> (L.) H.Karst.	MP	L	Dec	-	L	D	W	S	S ₃
327.	<i>Tamarix dioica</i> Roxb. ex Roth	NP	L	Dec	-	L	M	W	S	S ₃
76.		Thymelaeaceae								
328.	<i>Daphne mucronata</i> Royle.	NP	N	E	-	Sd	M	W	S	S ₁
77.		Verbenaceae								
329.	<i>Duranta repens</i> L.	NP	Mes	Dec	-	L	D	C	Com	S ₁
330.	<i>Lantana camara</i> L.	NP	Mes	Dec	-	L	D	C	Com	S ₁
331.	<i>Vitex negundo</i> L.	NP	Mes	Dec	-	L	D	W	Com	S ₁
78.		Vitaceae								
332.	<i>Vitis vinifera</i> L.	NP (Cl)	Mes	Dec	-	L	D	C	S	S ₂

		79.	Zygophyllaceae							
333.	<i>Fagonia indica</i> Burm.F.	Th	L	Dec	+	L	D	W	S	S2
334.	<i>Peganum harmala</i> L.	H	N	Dec	-	L	D	W	Dis.	S2
335.	<i>Tribulus pentandrus</i> Forssk.	Th	N	Dec	+	L	D	W	Com	S2
336.	<i>Tribulus terrestris</i> L.	Th	N	Dec	+	L	D	W	Com	S2

They were followed by Papilionaceae (20 Spp., 5.95 %), Brassicaceae (19 Spp., 5.65), Polygonaceae (14 Spp., 4.16%), Solanaceae and Chenopodiaceae (12 Spp; 3.57%) each respectively. The remaining families had less than 12 species in the area. Badshah *et al.* (2013) reported 205 species within 56 families while studying the flora of rangeland in district Tank. Khan *et al.* (2014) worked on the ecological characteristics and floristic composition of plants in Shahbaz Garhi Mardan. Hussain *et al.* (2015) identified 571 species belonging to 82 families while ecological characteristics and the diversity of flora of Mastuj valley; district Chitral, Hindukush Range, Pakistan Ullah *et al.* (2015) recorded 107 plant species belonged to 90 genera and 49 families of Sheikh

Buddin National Park, Dera Ismail Khan, Pakistan. Ali *et al.* (2016) studied floristic diversity of both cultivated and wild plants of Swat. Bibi *et al.* (2016) studied 30 plant species of 29 genera belong to 16 families, in which Poaceae was the most dominating family including 7 genera on the flora of road sides and central green belt of Motorway (M-1) from Peshawar to Charsadda Interchange. Shaheen reported 205 plant species belonged to 78 families from Havelian, District Abbottabad. Ullah (2016) reported 270 plant species of 65 families while studying the flora of District Pishin, Baluchistan. Ali *et al.* (2017) reported 104 plant species belonging to 46 families and 95 genera of Sherpao, district Charsadda.

Table 2. Summary of Floristic Diversity of Plants of Mir Ali subdivision, NWT, Pakistan in different major groups.

S#	Major group	Families		Genera		Species	
		NO.	%	NO.	%	NO.	%
i.	Pteridophytes	2	2.53	2	0.87	3	0.89
ii.	Gymnosperms	3	3.8	4	1.75	4	1.19
iii.	Monocotyledonae	11	13.92	45	19.65	60	17.85
iv.	Dicotyledonae	63	79.75	178	77.73	269	80.1
	Total	79	100	229	100	336	100

Biological spectra

Life form spectrum

Biological spectra indicate characteristic of the prevailing environmental and habitat conditions of an area. Plants species assume life form according to the climatic conditions for their survival. It was seen that life form spectrum (Tables 1 & 3.1) was dominated by therophytes (171 spp., 50.9%), followed by nanophanerophytes (43 spp, 12.79%), megaphanerophytes (37 spp., 11.2%), geophytes (32 spp., 9.52%), chamaephytes and hemicryptophytes (each 26 spp, 7.73%) There was one shoot (0.29%) parasitic species of *Cuscuta*. The present findings agree with Sher and Khan (2007) and Sher *et al.*

(2014). Devi & Sharma (2004) and Aleign *et al.* (2007) also reported the dominance of therophytes in their studies. The arrangement of life-form of a species in a natural series is known as biological spectrum and is based on life-form and leaf spectra. It represents climatic, microclimatic and bioclimatic habitat conditions of particular area (Cain, 1950; Cain and Castro, 1959). Nasir *et al.* (2016) studied 395 plant species belonged to 66 families in which hemicryptophytes (24.55%) were the dominant life form followed by therophytes (24.30). Shaheen *et al.* (2015) also reported 10 different life form classes which dominated by therophytes with 89 species (43.68%). Sher & Khan (2007) also reported that

therophytes were dominant (86 spp., 38.65 %) in Chagharzai Valley, District Buner.

Table 3. Summary of Ecological characteristics of Plants of Mir Ali Subdivision, North Waziristan, Pakistan.

3.1. Distribution of Plant species based on life form.

S#	Life form Classes	No. of species	%age
i.	Therophytes : Th	171	50.9
ii.	Nanophanerophytes : NP	43	12.79
iii.	Megaphanerophytes : MegP	37	11.01
iv.	Geophytes : G	32	9.52
v.	Chamaephytes : Ch	26	7.73
vi.	Hemicryptophytes : H	26	7.73
vii.	Parasites : P	1	0.29
	Total	336	100

3.2. Distribution of plant species according to leaf sizes

S#	Leaf size Classes	No. of species	%age
i.	Nanophylls : N	139	41.4
ii.	Microphylls : Mic	65	19.34
iii.	Leptophylls : L	52	15.5
iv.	Mesophylls : Mes	50	14.9
v.	Macrophylls : Mac	18	5.4
vi.	Megaphylls : Meg	9	2.68
vii.	Aphyllous : AP	3	0.59
	Total	336	100

3.3. Distribution of plant species according to leaf persistency

S#	Leaf categories	No. of species	%age
i.	Deciduous	313	93.15
ii.	Evergreen	20	5.95
iii.	Aphyllous	3	0.9
	Total	336	100

3.4. Distribution of plant species according to Spiny nature

S#	Spiny nature	No. of species	%age
i.	Nonspiny	283	84.22
ii.	Spiny	53	15.78
	Total	336	100

3.5. Distribution of plant species in various habitat

S#	Habitat condition	No. of species	%age
i.	Dry	276	82.14
ii.	Moist	60	17.86
	Total	336	100

3.6. Distribution of plant species according to light requirement

S#	Light requirement	No. of species	%age
i.	Light : Heliophytes	332	98.8
ii.	Shade : Sciophytes	4	1.2
	Total	336	100

3.7. Distribution of plant species according to Wild/ Cultivated characters

S#	Habit	No. of species	%age
i.	Wild	243	72.32
ii.	Cultivated	93	27.67
	Total	336	100

3.8. Distribution of plant species according to lamina shape

S#	Leaf Morphology	No. of species	%age
i.	Simple	233	69.35
ii.	Compound	52	15.48
iii.	Dissected	48	14.28
iv.	Leafless	3	0.89
	Total	336	100

3.9. Distribution of plant species according to Phenology

S#	Phenological stages	No. of species	%age
i.	Reproductive : S2	223	66.36
ii.	Pre- Reproductive : S1	84	25
iii.	Post-Reproductive : S3	29	8.63
	Total	336	100

The life-form of a plant species is a constant characteristics but sometimes it varies with different environmental conditions and species go through different life-form stages in its life cycle from seed to maturity (Ajaib *et al.*, 2008). Khan *et al.* (2018) reported that hemicryptophytes (80 spp., 31.74%) were dominant followed by megaphanerophytes (51 spp., 20.24%) in Thandiani forest, Abbotabad.

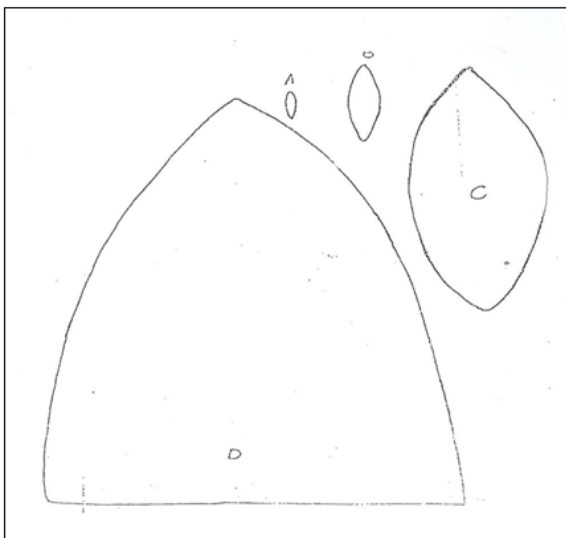


Fig. 2. Raunkiaer (1934) Leaf size diagram.

The life form of the vegetation is the product of their genetic pool and tolerance towards the climatic variation. Life-form reflects the environmental and biotic influences prevailing in a particular locality. In the present study therophytes, nanophanerophytes, chamaephytes and megaphanerophytes were the major floristic elements. This agrees with the prevailing environmental condition of the Mir Ali subdivision. *Accacia modesta* population size has decreased over the years due to heavy demand as fuel

wood and its slow regeneration.

Leaf size spectrum

The leaf size classification and their spectrum are shown in (Tables 1, 3.2). It is evident that nanophyll was leading leaf-size class with 139 (41.4%) species. It was followed by microphyll (65 spp., 19.34%), leptophyll (52 spp., 15.5%), mesophyll 50 (14.9%), 18 (5.4%) of macrophyll and 9 (2.68%) species megaphyll. Three species (0.59%) were aphyllous. The leaf-size knowledge is helpful in understanding the physiological processes of plant species.

The dominance of semi leaved species *i.e.*, macrophyllous 18 (5.4%) and megaphyllous 9 (2.68%) were well in coordination arid climate with cold winters. Shaheen *et al.*, (2015) reported that microphyll was dominated with 98 species (47.80%). Nasir *et al.* (2016) reported the leaf size spectra of Taloqa Hills, Muzafarabad and microphyll (42%) was dominant followed by leptophyll (28%). Khan *et al.* (2018) reported leaf size spectra in Thandiani forest showed that (34.92%) microphyll were dominant followed by leptophyll (29.36%). The present study suggests further extensive and intensive exploration of species in the area. Plant species adapt themselves to changing environmental condition by their morphological and physiological modification. Habitat conversion, grazing, deforestation, pollution and climate changes reduce the plant cover and ultimately lead to plant extinction. It is recommended that a complete illustrated flora with taxonomic treatment along with keys for identification, figures and diagrams must be written.

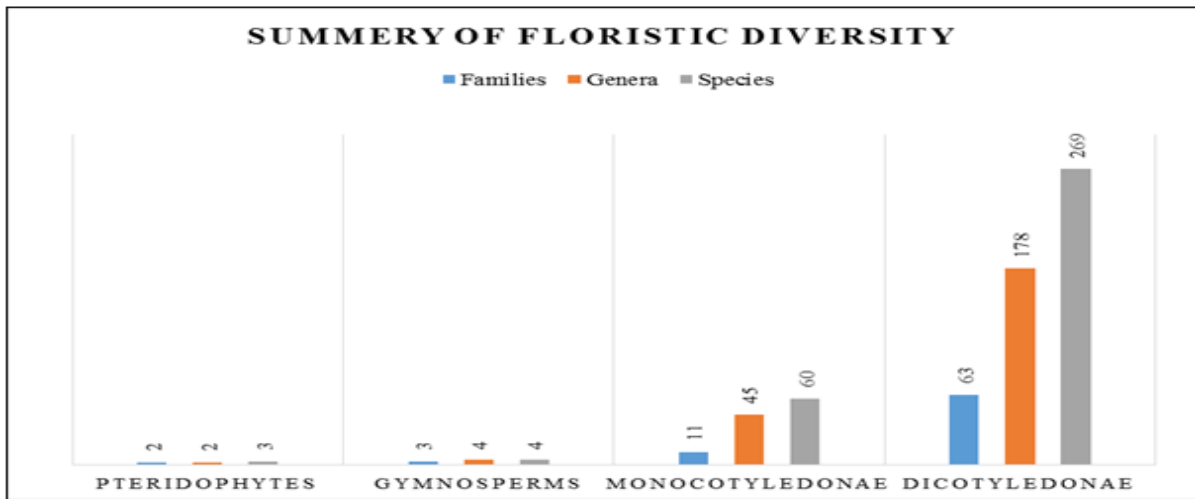


Fig. 3. Summary of Floristic Diversity.

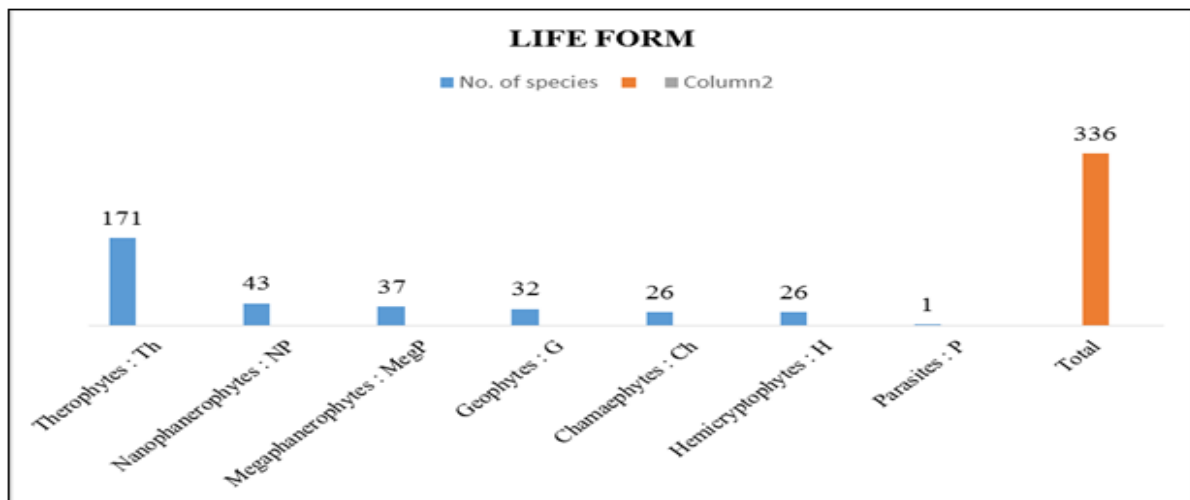


Fig. 4. Distribution of plant species according to life form spectra.

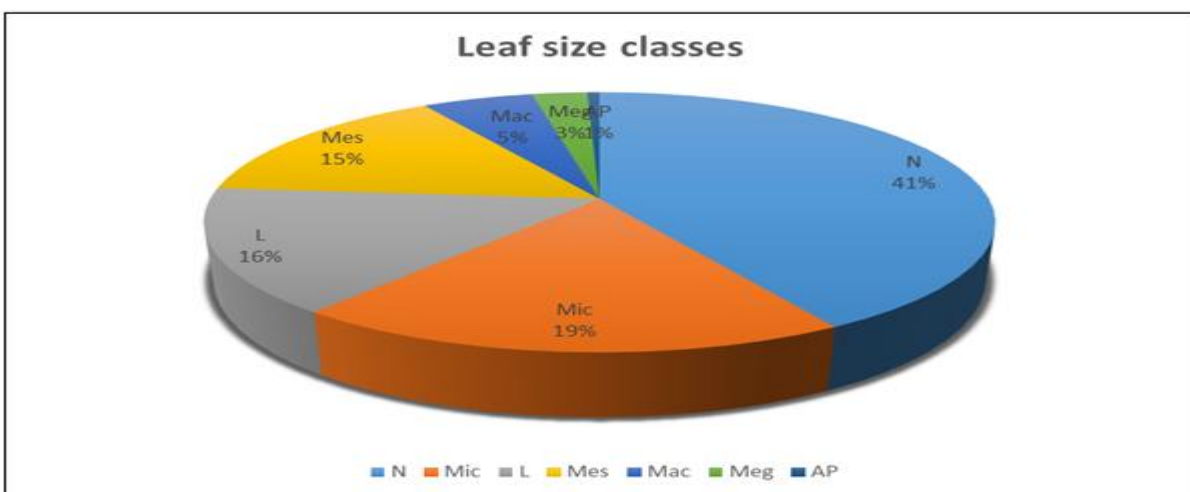


Fig. 5. Distribution of plant species according to life size classes spectra.

Ecological characteristics

There were 3 (0.9%) aphyllous species, 313 (93.15%) deciduous species and only 20 (5.95%) evergreen

species (Table 3.3). The rain fall is poor that does not favor the evergreen species.

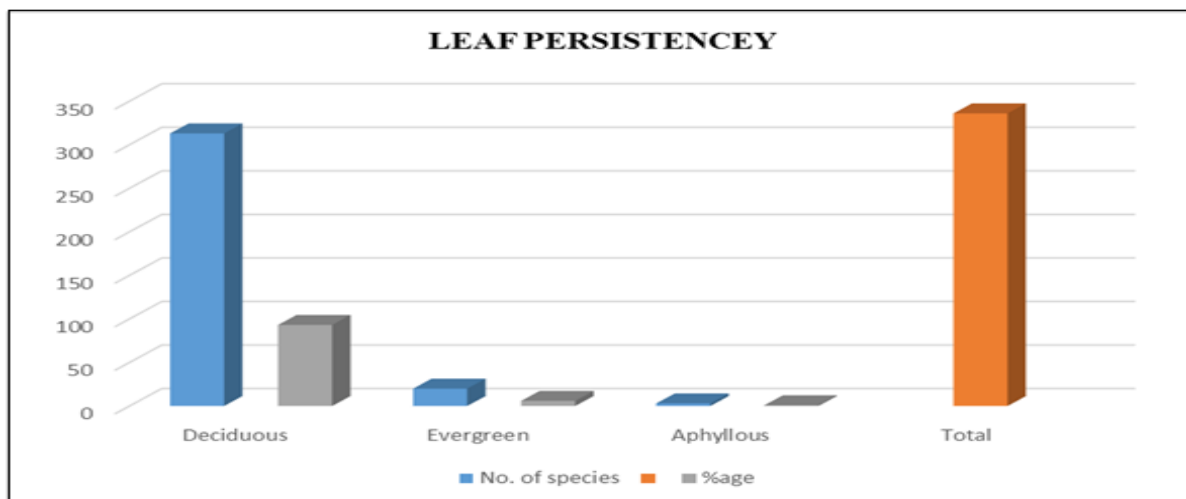


Fig. 6. Distribution of plant species according to leaf persistence spectra.

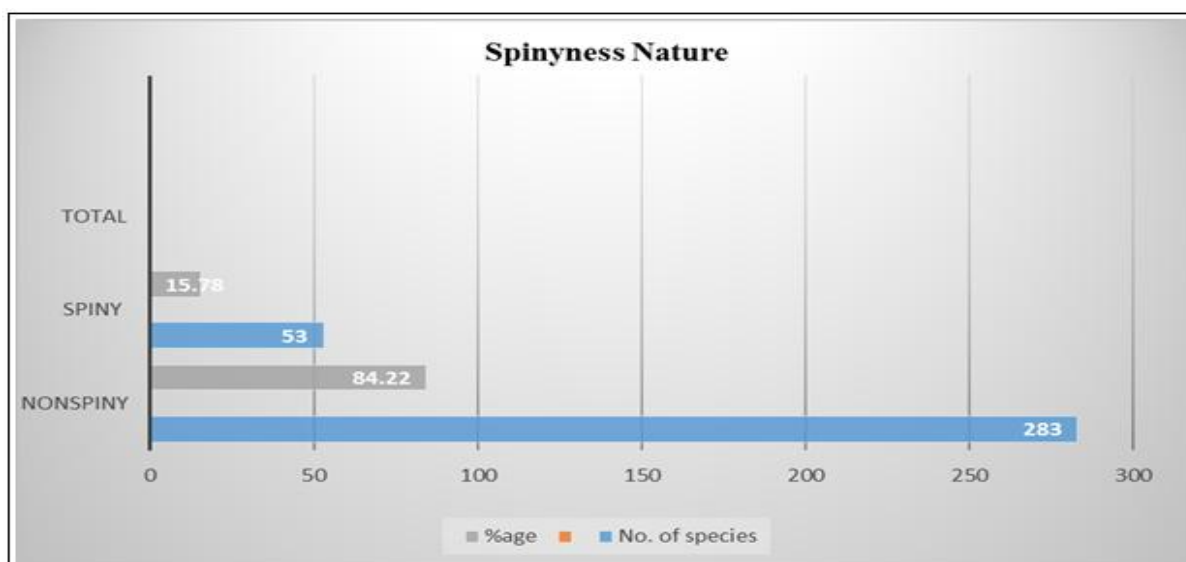


Fig. 7. Distribution of plant species according to spinyess spectra.

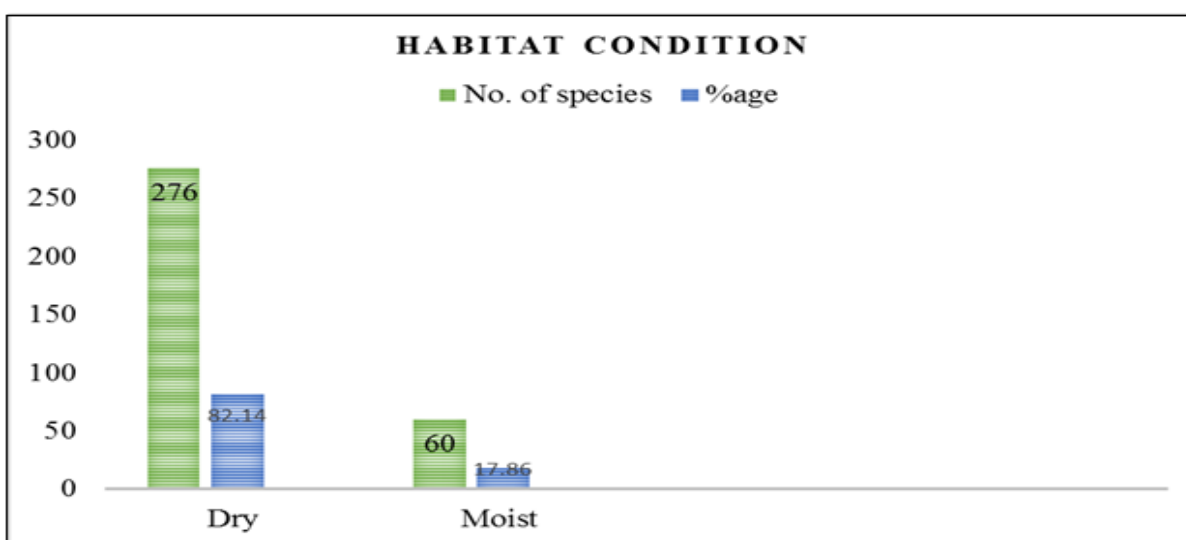


Fig. 8. Distribution of plant species in various habitats.

There were 283 (84.22%) non spiny and 53 (15.78%) spiny species in the area (Table 3.4). 276 (82.14%) species were found on dry habitat and 60 (17.86%) inhabited moist habitat (Table 3.5).

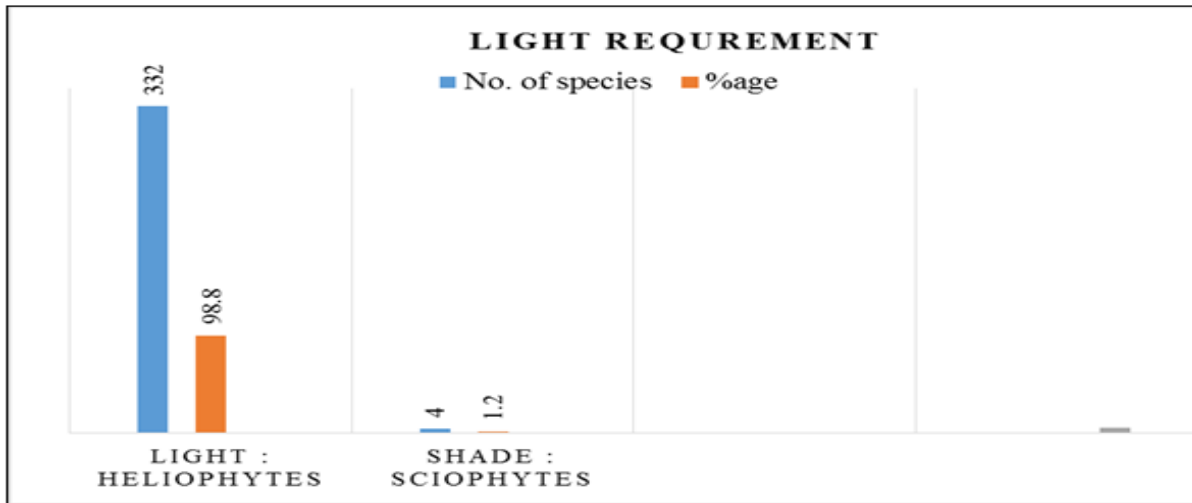


Fig. 9. Distribution of plant species according to light requirement.

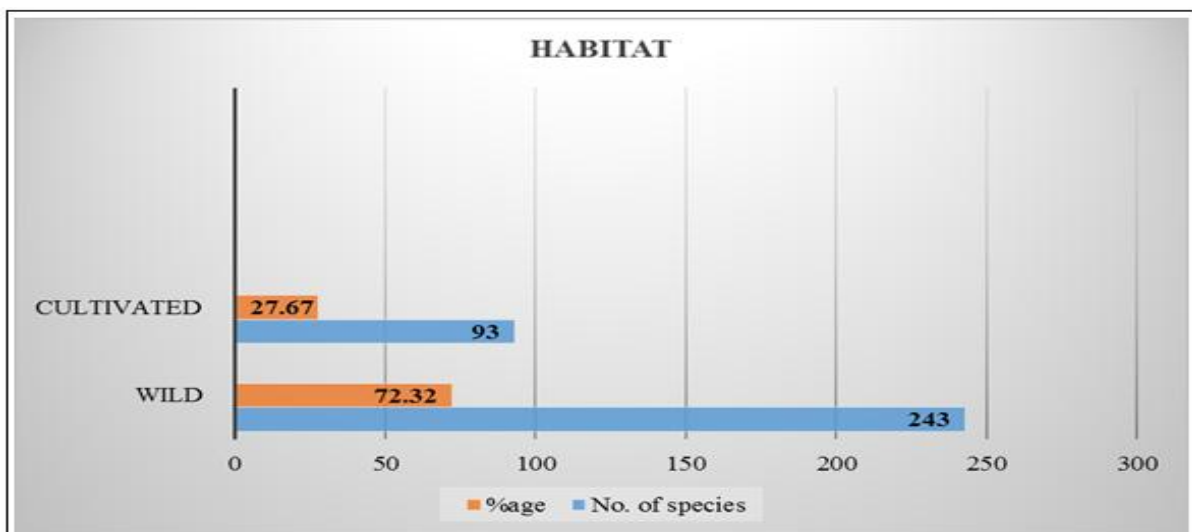


Fig. 10. Distribution of plant species according in various habit (Wild/ Cultivated plants).

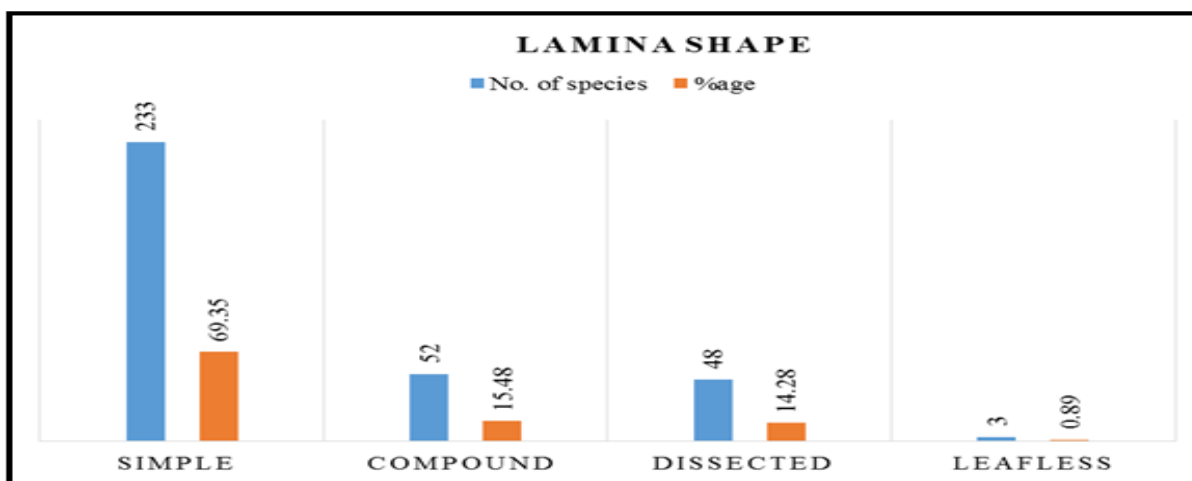


Fig. 11. Distribution of plant species according to lamina shape.

Three species (0.89%) were aphyllous. 332 (98.8%) need light requirement while 4 (1.2%) species were found in shady places (Table 3.6). There were 243 (72.32%) wild and 93 (27.67%) cultivated plant species respectively (Table 3.7). *Oryza sativa*, *Triticum aestivum*, *Allium sativum*, *Allium cepa*, *Zea*

mays and *Coriandrum sativum* are some of the cultivated plant species in the research area. The leaves were simple in 233 (69.35%) species, compound in 52 (15.48%) species and dissected in 4 (14.28%) species.

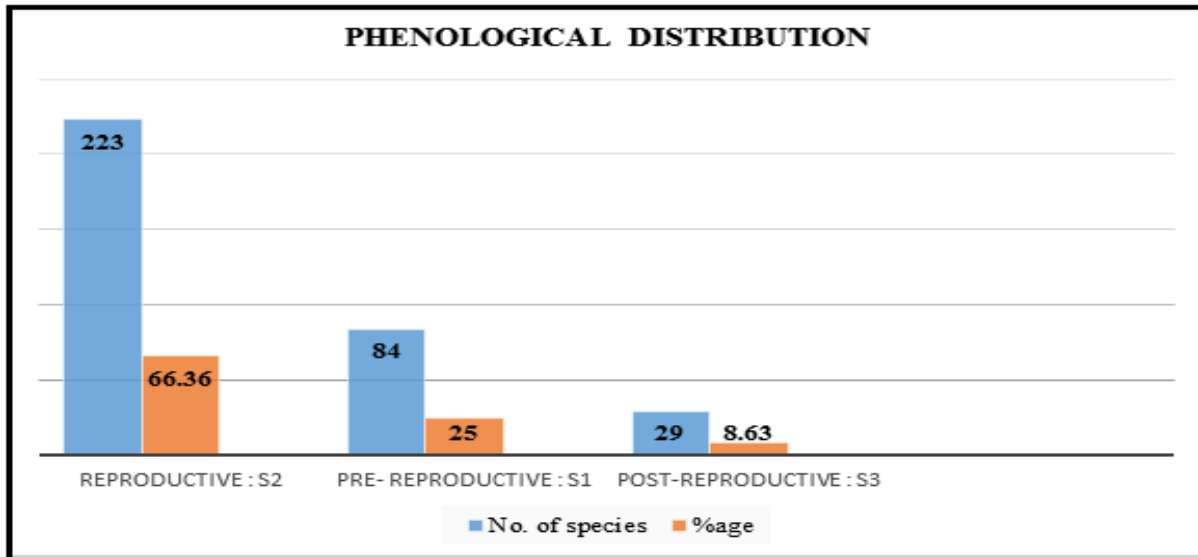


Fig. 12. Distribution of plant species to according to phenology.



Fig. 13. *Adiantum capillus veneris* L.



Fig. 15. *Phoenix dactylifera* L.



Fig. 14. *Calotropis procera* (Wild.) R.Br.



Fig. 16. *Nannorrhops ritchiana* (Griff.) Aitchison

(Table 3.8). The phenological study showed that 223 (66.36%) species were at reproductive, 84 (25%) species at pre-reproductive and 29 (8.63%) species were at post-reproductive stages (Table 3.9). Some Economically Important Plants of Mir Ali Subdivision, North Waziristan, Pakistan.



Fig. 17. *Capparis spinosa* L.



Fig. 18. *Monotheca buxifolia* (Falc.) A. DC.

Keys: 1. Life form: Th. Therophytes, G. Geophytes, H. Hemicryptophytes, Ch. Chamaephytes, NP. Nanophanerophytes, MP. Megaphanerophytes, Cl. Climber, P. Parasite.

2. Leaf Size: AP. Aphyllous, L. Leptophyll, N. Nanophyll, Mic. Microphyll, Mes. Mesophyll, Mac. Macrophyll, Meg. Megaphyll.

3. Leaf Persistence: E. Evergreen, Dec. Deciduous

4. Spiny: + Spiny, - Non spiny

5. Light requirement: L. light, Sd. Shade

6. Habitat: A. Aquatic, M. Moist, D. Dry

7. Habit: C. Cultivated, W. Wild

8. Leaf appearance: S. Simple, Com. Compound, Disec. Dissected, Abs. Absant.

9. Phenological stages: Pre-Rep. Pre-reproductive S1, Rep. Reproductive S2, Post-Rep. Post-Reproductive S3.

Conclusion

The present study was carried out during 2016-2018 to assess ecological evaluation and phytodiversity of vascular plant species of Mir Ali subdivision, North Waziristan Agency, Pakistan. A total of 336 species belonging to 229 genera and 79 families were collected and identified. It includes 269 dicots, 60 Monocots, 4 Gymnosperms and 3 Pteridophyte species. Study also revealed that life form classes were dominated by Therophytes (171 spp., 50.9%), followed by Nanophanerophytes (43 spp., 12.79 %) and megaphanerophytes had (37 spp., 11.01%). Leaf size spectrum showed that leading leaf size classes were nanophylls with 139 (41.4%) species, microphylls 65 (19.34%) species and leptophylls consisted of 52 (15.5%) species which were determined by Raunkier's method. There were 313 (93.15%) deciduous species, 20 (5.95%) evergreen species and 3 (0.9%) aphyllous plant species. A total of 283 (84.22%) non spiny plants and 53 (15.78%) spiny plant species were also recorded. 276 (82.14%) species lived in terrestrial habitat and 60 (17.86%) dwelled in mesic habitat were also identified. 332 (98.8%) need light requirement while 4 (1.2%) species were found in shady places. There were 243 (72.32%) wild species and 93 (27.67%) were alien/cultivated plant species. 233 (69.35%) species had simple, 52 (15.48%) compound, 48 (14.28%) dissected while 3 (leafless) in leaf structure. The phenology showed that 223 (66.36%) species were found at reproductive (S2), 84 (25%) pre-reproductive (S1) and 29 (8.63%) at post-reproductive (S3). Distribution of plant species was disturbed due to atmospheric, edaphic and biotic factors. The study concluded that the research area is hot Centre of plant biodiversity which is under heavy biotic pressure of grazing, overharvesting and deforestation. Conservation practices, sustainable collection and utilization are

strongly recommended.

Acknowledgements

This is the part of PhD thesis of First Author. The authors are thankful to supervisor Dr. Syed Mukaram Shah Center of Plant Biodiversity University of Peshawar.

Graphs

Ahmad W, Qurashi R.U, Arsad M. 2019. Floristic, Frequency and vegetation- biological spectra of Murree Kotli Sattian-Kahuta national park, Pakistan. *Pakistan Journal of Botany* **5(2)**, 637-648.

Ajaib M, Khan Z, Muhammad S, Muhammad R. 2008. Biological Spectra of Saney Baney hills district Kotli Azad Jammu and Kashmir. *Pakistan Journal of Science* **60(1-2)**, 53-58.

Alelign A, Teketay D, Yemshaw Y, Edwards S. 2007. Diversity and status of regeneration of woody plants on the peninsula of Zegie, northwestern Ethiopia. *Journal of Tropical Ecology* **48(1)**, 37-49.

Ali A, Badshah L, Hussain, F, Shinwari ZK. 2016. Floristic composition and ecological characteristics of plants of Chail Valley, District Swat, Pakistan. *Pakistan Journal of Botany* **48(3)**, 1013-1026.

Ali SI, Qaiser M (Eds.). 1993-2019. Flora of Pakistan. Department of Botany, University of Karachi.

Ali SI, Qaiser M. 1986. A phytogeographical Analysis of Phanerogams of Pakistan and Kashmir. *Proceedings of the Royal Society of Edinburgh* **89B**, 89-101.

Ali SI, Nasir YJ (Eds.). 1989-1991. Flora of Pakistan. Islamabad, Karachi. 191- 193.

Ali S, Shuaib M, Ali H, Ullah S, Ali K, Hussain S, Hassan N, Zeb U, Khan UM, Hussain F. 2017. Floristic list and their ecological characteristics,

of plants at village Sherpao District Charsadda, KP-Pakistan. *Journal of medicinal plants studies* **5(5)**, 295-299.

Amber K, Khan KR, Shah AH, Lodhi MF, Husain M, Shah GM. 2019. A comprehensive survey of floristic diversity evaluating the role of institutional gardening in conservation of plant biodiversity. *International Journal Bioscience* **(14)3**, 325-339.

Anwar S, Khan SM, Ahmad Z, Ullah Z. 2019. Floristic composition and ecological gradient analyses of the Liakot Forests in the Kalam region of District Swat, Pakistan. *Journal of Forest Research* **30(4)**, 1407-1416.

Badshah L, Hussain F, Akhtar N. 2010. Vegetation structure of subtropical forest of Tabai, South Waziristan, Pakistan. *Front Agriculture China* **4(2)**, 232-236.

Badshah L, Hussain F, Sher Z. 2013. Floristic inventory, ecological characteristics and biological spectrum of rangeland, District Tank, Pakistan *Journal of Botany* **45(4)**, 1159-1168.

Bibi SF, Badshah L, Din SU. 2016. Floristic Composition of Verges of Motorway (M-1) Peshawar to Charsadda, Pakistan. *Sarh. Journal of Agriculture* **32(4)**, 405-416.

Cain S.A. 1950. Life form and phytoclimates. *The Botanical Review* **16**, 1-32.

Cain SA, Castro GM. 1959. *Manual of Vegetation analysis*. Harper, New York. P 325.

Daud M, Wazir SM, Khan R.U, Khan SU, Khan A, Ullah I, Khattak A. 2013. Ethnotaxonomical study of gymnosperms of Razmak North Waziristan agency. *Canadian Journal of Applied Sciences* **2(4)**, 440-458.

Devi NB, Sharma BM. 2004. Life-form analysis of

the macrophytes of the Loktak Lake, Manipur, India. In: Kumar. Biodiversity and Environment, p 139-148.

Durrani MJ, Razaq A, Muhammad SG, Hussain F. 2010. Floristic diversity, ecological characteristics and ethnobotanical profile of plants of Aghberg rangelands, Baluchistan, Pakistan. Pakistan Journal of Plants Science **16(1)**, 29-36.

Gazal S, Raina AK. 2015. Life form Composition and Biological Spectrum of Ramnagar ildlife sanctuary, J&K, India. International Journal of Science and Research **4**, 2319-7064.

Haq SM, Malik AH, Khuroo AA, Rashid I. 2018. Floristic composition and biological spectrum of Keran a remote valley of northwestern Himalaya, Pakistan. Acta Ecologica Sinica. 00634, **8**.

Hussain F. 1989. Field and Laboratory Manual of Plant Ecology University Grants Commission, Islamabad.

Hussain F, Shah SM, Badshah L, Durrani MJ. 2015. Diversity and ecological characteristics of flora of Mastuj valley, district Chitral, Hindukush range, Pakistan. Pakistan Journal of Botany **47(2)**, 495-510.

Iqbal M, Jabeen S, Jamil S, Umer S, Nawaz I, Manzoor N. 2019. Floristic composition and indigenous uses of grass flora of western areas of Dera Ghazi Khan, Punjab, Pakistan. Merit Research Journal of Microbiology and Biological Sciences **2408-7076(1)**, 001-007.

Khan W, Khan S.M, Ahmad H, Alqarawi A, Shah GM, Hussain M, Allah A. 2018. Life forms, leaf size spectra, regeneration capacity and diversity of plant species grown in the Thandiani forests, district Abbottabad, Khyber Pakhtunkhwa, Pakistan. Saudi Journal of Biological Sciences **25**, 94-100.

Khan A, Khan N, Kishwar A, Rahman IU. 2017. An assessment of the floristic diversity, life-forms and biological spectrum of vegetation in Swat

Ranizai, District Malakand, Khyber Pakhtunkhwa, Pakistan. Journal of Science, Technology and Development **36(2)**, 61-78.

Nasir E, Ali SI. 1970-1989. Flora of Pakistan. No. 1-190. Pakistan Agriculture Research Council, Islamabad.

Nasir M, Khan MQ, Mehmood A. 2016. Life form, biological spectrum and ethnomedicinal uses of the flora of Taloqa hills, Western Himalayas, Muzaffarabad. International Journal of Bioscience **9(6)**, 8-18.

Qaisar M, Farooq S, Gilani SN, Wasim MA, Kakar M, Shah SWA, Rauf A. 2013. Ethnobotanical survey of medicinal plants used in Wazir and Daur tribes of North Waziristan, Pakistan. Global Veterinaria **11(3)**, 285-292.

Rafay M, Khan R.A, Yaqoob S, Ahmad M. 2013. Nutritional evaluation of major range grasses from Cholistan Desert. Pak. J. Nutrition **12**, 23-29.

Raunkiaer C. 1934. The Life Forms of Plants and Statistical Plants Geography Being the Collected Papers of C. Raunkiaer. Oxford: Clarendon Press.

Rashid A, Swati MF, Sher Yemeni MNAL. 2011. Phyteoecological evaluation with detail floristic appraisal of the vegetation around Malam Jabba, Swat, Pakistan. Asian Pac. J. Trop. Biomed **1(6)**, 461-467.

Saima S, Dasti A.A, Hussain F, Wazir SM, Malik SA. 2009. Floristic composition along an 18-km long transect in ayubia national park, District Abbottabad, Pakistan. Pakistan Journal of Botany **41(5)**, 2115-2127.

Samad M, Badshah L, Khan SM. 2018. Biological spectra of Lala Kalay area district Peshawar Khyber Pakhtunkhwa, Pakistan. Pak. J. Weed Sci. Res. **24(4)**, 353-362.

Sher Z, Khan Z. 2007. Floristic composition, life-form and leaf spectra of the vegetation of Chagharzai Valley, District Buner. *Pakistan Journal of Plant Science* **13(1)**, 55-64.

Sher Z, Hussain F, Badshah L. 2014. Biodiversity and ecological characterization of the flora of Gadoon rangeland, District Swabi, Khyber Pakhtunkhwa, Pakistan. *The Iran journal of Botany* **20**, 96-108.

Shaheen H, Sarwar R, Firdous SS, Dar MEI, Ullah Z, Khan SM. 2015. Distribution and Structure of Conifers with special emphasis on *Taxus Baccata* Moist Temperate Forests of Kashmir Himalayas. *Pakistan Journal of Botany* **47(SI)**, 71-76.

Shimwell DW. 1971. *The Description and Classification of Vegetation* Sedgwick and Jackson, p: 322. London.

Ullah A, Khan N, Muhammad M. 2015. Diversity of life-form and leaf size classes at Sheikh Buddin National Park, Dera Ismail Khan, Khyber Pakhtunkhwa, Pakistan. *Asian Journal of Life sciences* **3(1)**, 6-13.

Ullah I, Din SU, Ullah F, Khan SU, Khan A, Khan RA, Shah M, Zulqarnain S. 2016. Floristic composition, ecological characteristics and biological spectrum of District Bannu, Khyber Pakhtunkhwa, Pakistan. *Journal Human Ecology* **54**, 1-11.

Wazir R, Asim M, Subhan M, Khan I, Ali M. 2014. Morpho-Anatomical features of weeds flora of rain fed maize field in Mir Ali, North Waziristan Agency, Pakistan. *Pakistan Journal of Weed Science of Research* **20(3)**, 385-403.