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ORIGINAL ARTICLE

Floral diversity and phytosociological studies on vegetation of agror valley, district Mansehra

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The present study was conducted in Agror Valley in order to explore the species diversity and vegetation structure. A total of 142 species which belonged to 124 genra and 66 families were recorded. Asteraceae was the leading family with 17 species followed by Rosaceae 12 species, Lamiaceae 09 species and Polygonaceae 06 species. Based on plant growth habit, herbaceous growth form dominated the study area with 96 species (67.60%), followed by trees with 29 species (20.42%) and shrubs 17 (11.97%) species. Biological spectrum showed that therophyte was dominant life class represented with 61 plant species (42.95%), followed by Megaphanerophytes and Hemicryptophytes 20 species (14.08%) each. Microphyll flora was the leading leaf size spectra with 73 species (51.40%), followed by Mesophyll 32 (22.53%), Nanophyll 26 (18.30%), Leptophylls 10 (7.04%) species and Megaphyll contributing 1 species (0.70%). Seasonal variation of species diversity disclosed that two flowering seasons were recorded, one from May to August during which 137 (96.47%) plant species showed flowering and second from September to November in which 5 (3.52%) plant species flowered. Maximum flowering (42 plant species) occurred during the month of March while May to August were the peak fruiting months in the study area. This study will help botanists, conservationists, ecologists, and policy makers to improve, protect and manage the present vegetation status and sustainably for future generations.

Keywords: Biodiversity, Floristic composition, Raunkiaer classification, Phenology, Oghi, Conservation.

Introduction

Biodiversity may be defined as the variety of life forms i.e., all species of plants, trees, other flora, insects, animals, and other microorganisms. Khyber Pakhtunkhwa Province has an enoromous diversity of flora and a huge variety of ecological zones scattered throughout the province from the plains in the south to high mountains in the north (Champion et al., 1965), the forests fall under the major type "Montane temperate forests" (Shah and Khan, 2006). Tehsil Oghi (Mansehra), Pakistan, has a rich plant biodiversity due to the presence of diverse microhabitats and topographic features (Ahmed et al., 2018).

Biological spectrum is the percentage ratio of life form of plant present in an area (Sarmiento and Monasterio, 1983). Biological spectrum is used both for the life form distribution pattern of vegetation and environmental conditions under the prevailing life forms progressed. Same climatic conditions in different regions can be specified by occurrence of similar biological spectra (Raunkiaer, 1934). Leaf size classes have been found to be very useful for plant associations. Size and shape of leaves associate strongly with environmental variables like temperature and moisture (Bailey and Sinott 1995). The physiological processes of plants can be accessed through leaf size (Oosting, 1956).

Floristic studies across the globe have been documented by several field investigators. Cain and Castro (1959) and Shimwell (1971) reported that hemi cryptophytes are characteristic of temperate zones; therophytes of desert climate and geophytes of the Mediterranean climate. Ram and Arya (1991) examined and stated phanerophytes dominant life form before degradation and therophytic and hemicryptophytic after degradation in the alpine meadows of Central Himalaya, India.

Phenology is the relationship of plant growth stages and calendar date. The calendar is based on the solar year. The information of phenology shows relationship of plant growth to seasonal changes and changes in length of day light or photoperiod to program their growth stages and biological activities appropriated with the seasonal conditions (Manske, 2006). Phenology is the timing of recurring of biological events, among phases of plant species, which provide a background for collecting and synthesizing detailed quantitative information on rhythm of plant community (Sing and Sing, 1992). According to Ahmed (2017), the flowering and fruiting could be related with the climatic conditions for offspring survival. Cornejo-Tenoria and Ibarra-Manriquez (2007) recorded flowering and fruiting behavior on monthly basis. Keeping these points in view, the current study was designed to evaluate and document the floristic composition, biological spectra and phenological behaviour of the local flora of an unexplored valley (Agror Valley), Mansehra, Pakistan.

Materials and Methods

Study area

The Agror Valley is located in Mansehra District of Hazara Division, Khyber Pakhtunkhwa. It is situated between 34°29' and 34°35'N and 72°58' and 75°09'E (Hunter, 1885). It lies at the base of Black Mountain and is segregated from Pakhli by the Tanglai Mountain (Mustafa, 2003). On its east lies Battal, on north lies Batagram and from Agror southward are Tanwal Mountains. The old name of Oghi was Agror Valley, and since the town Oghi is in close proximity to the centre city and being an old town (1000 year), the entire area is currently being known as Oghi. The total study area comprises of 22,991 acres. The valley consists of five union councils; Oghi, Belian, Kathai, Shamdarha and Dilbori (Ahmed et al., 2017). Total population of Tehsil Oghi is 265,728 (Pakistan Bureau of Statistics, 2017) (Fig. 1).

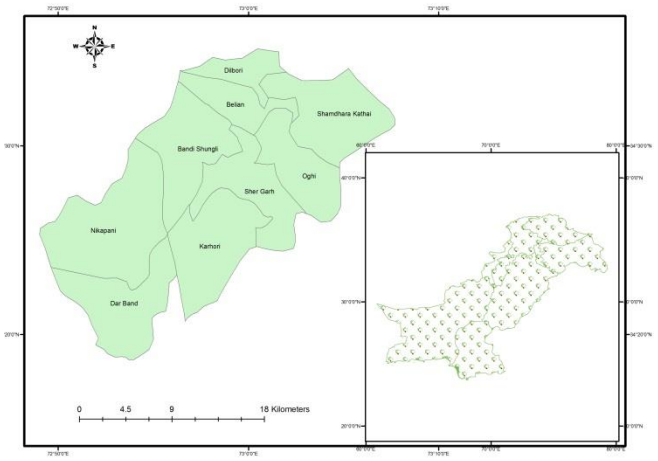

Fig. 1. Map of Agror valley.

Field surveys

Field surveys were carried out to investigate and examine the biodiversity of the study area in different seasons. Every study trip was well planned and performed effectively. Phenology of the species was recorded in different intervals of field year (Singh and Singh, 2010). Surveys were conducted during flowering and fruiting stages. Significant plant affiliations were studied, with relationship to altitude and environmental conditions. Timings for the field work were preferred according to the growth and collection season of plants. Each specimen was assigned collection number with the aid of tags. Field data were noted in field notebook. Collection number was given to each specimen with the help of tags. Each collected plant specimen was serially tagged and placed in the field presser (Ijaz et al., 2015).

Herbarium work

The collected specimens were poisoned using mercuric chloride (2gm) and absolute alcohol (1000 ml). The poisoned species were pasted on the herbarium sheets having standard size (11.5 × 17.5 inches) (Ijaz et al., 2016). Field notebook data were shifted to herbarium slip (4 × 6 inches) glued underside on right part of herbarium sheet (Ijaz, 2014). For the identification of plants taxonomic literature, previously published credentials and for authenticity Flora of Pakistan was consulted (Ali and Nasir, 1970-2002). The plants names were also validated and brought up to date with the online internet site (www.theplantlist.org) of the Royal Botanic Gardens, Kew. The voucher specimens were placed in Herbarium, Department of Botany, Hazara University Mansehra, Pakistan (HUP).

Biological spectrum

The two parameters of biological spectrum i.e., life form classes and leaf spectra of all plant species were recognized and categorized after Raunkiaer (1934).

Life form

Life form indicates the adjustment of plant life to various climatic events. Based on position of the perennating buds, the Raunkiaer (1934) proposed life form classes.

Phanerophytes (P)

Phanerophytes includes all tall woody trees and shrubs. Perennating buds emerges 25 cm, or more above the grounds. Phanerophytes were subdivided into following four sub-classes.

1) Mega phanerophytes (Mp): Trees with more than 30 m height.
2) Meso phanerophytes (Ms): Trees with height between 8-30 m.
3) Micro phanerophytes (Me): Trees and shrubs comprising height in range of 2-8 m.

4) Nano phanerophytes (NP): Shrubs with 25 cm - 2 m height.

Chameophytes (CH)

Perennating buds lying above the soil surface up to 25 cm. This class mostly includes small sized shrubs.

Hemicryptophytes (H)

Hemicryptophytes includes plant species having their perennating buds on the surface of soil. This group includes all grasses.

Geophytes (G)

Perennating buds are present under the ground surface. They include bulbs, tuber, corm, and rhizomes.

Therophytes (Th)

This class included annual plants species which completes their life cycle during favourable conditions throughout the year. Their perennating buds are present in the form of seeds e.g., the members of Asteraceae family.

Leaf Spectra

Leaf size classes were determined by following Oosting (1956).

Leptophyll (L)

The leaf area is 25 square mm.

Nanophyll (N)

The leaf area is 225 square mm.

Microphyll (Mi)

The leaf area is 2025 square mm.

Mesophyll (Me)

The leaf area is 18225 square mm.

Megaphyll (Ma)

The leaf area is 164025 square mm.

Phenology

The phenological attributes of plant species i.e., flowering and fruiting were recorded during the field visits of the study area every month during 2018-2019.

Results

Floristic composition

The flora of Agror Valley comprised of 142 species belonging to 124 genra and 66 families. Asteraceae was the dominant family with 17 species, followed by Rosaceae 12 species, Lamiaceae 09 species and Polygonaceae 06 species. Based on plant growth habit, herbaceous growth form dominated the study area with 96 species (67.60%), followed by trees with 29 species (20.42%) and shrubs 17 (11.97%) species (Table 1).

Clasification of plants based on life form and leaf spectra

Life form

The results revealed that the dominant life form in the study area was Therophytes with 61 plant species (42.95%), followed by Megaphanerophytes and Hemicryptophytes 20 species (14.08%) each, Nanophanerophytes 17 plant species (11.97%), Geophytes 12 species (8.45%), Mesophanerophytes05 plant species (3.52%), Chamaephytes 04 plant species (2.81%), Microphanerophytes 02 plant (1.40%), Lianas 01 plant species (0.70%) (Tables 1 and 2).

Leaf spectrum

The leaf size spectra were dominated by Microphyll flora with 73 species (51.40%), followed by Mesophyll 32 (22.53%), Nanophyll 26 (18.30%), Leptophylls 10 (7.04%) species and Megaphyll contributing 01 species (0.70%) only (Tables 1 and 3).

Table 1. Life form and Leaf spectra of different taxa reported from Agror Valley.

S. No.	Plant Species	Family Name	Habit	Life Form Classes		Phenology	
				Life Form	Leaf Spectra	Flowering	Fruiting
1.	*Achyranthes aspera* L.	Amaranthaceae	H	TH	Mic	April	June
2.	*Adiantum capillus-veneris* L.	Pteridaceae	H	TH	N	May	June
3.	*Ailanthus altissima* (Mill.) Swingle	Simaroubaceae	T	MP	Mic	April	June
4.	*Ajuga integrifolia* Buch.-Ham.	Lamiaceae	H	TH	N	April	July

5.	*Alnus nitida* (Spach) Endl.	Betulaceae	T	MP	Mes	August	November
6.	*Anagallis arvensis* L.	Primulaceae	H	TH	N	July	September
7.	*Anaphalis margaritacea* (L.) Benth&Hook.f.	Asteraceae	H	H	Mes	August	September
8.	*Arisaema jacquemontii* Blume	Araceae	H	G	Mes	May	July
9.	*Artemisia absinthium* L.	Asteraceae	H	H	Mes	April	August
10.	*Arundo donax* L.	Poaceae	H	G	Mes	August	September
11.	*Asplenium ceterach* L.	Aspleniaceae	H	G	Mes	August	September
12.	*Avena sativa* L.	Poaceae	H	TH	Mic	July	August
13.	*Berberis lycium* Royle	Berberidaceae	S	NP	Mic	June	July
14.	*Bergenia ciliate* (Haw.) Sternb.	Saxifragaceae	H	G	Mes	March	May
15.	*Bistorta amplexicaulis* (D. Don) Greene	Polygonaceae	H	H	Mes	March	June
16.	*Bromus secalinus* L.	Poaceae	H	TH	L	June	July
17.	*Broussonetia papyrifera* (L.) L'Hér. Ex Vent.	Moraceae	T	MesP	Mes	August	September
18.	*Buglossoides arvensis* (L.) I.M.Johnst.	Boraginaceae	H	H	Mic	June	August
19.	*Bupleurum falcatum*L.	Apiaceae	H	H	Mic	March	May
20.	*Cannabis sativa* L.	Cannabaceae	H	TH	Mic	June	July
21.	*Capsella bursa-pastoris* (L.) Medik.	Brassicaceae	H	TH	Mic	May	July
22.	*Carex flava* L.	Cyperaceae	H	TH	Mic	September	October
23.	*Cedrus deodara* (Roxb. Ex D.Don) G.Don	Pinaceae	T	MP	N	August	September
24.	*Celtis australis* L.	Ulmaceae	T	MesP	Mic	April	July
25.	*Cenchrus ciliaris* L.	Poaceae	H	H	L	July	October
26.	*Centaurea iberica* Trevir. Ex Spreng.	Asteraceae	H	H	Mes	March	May
27.	*Chenopodium album* L.	Chenopodiaceae	H	TH	Mic	June	August
28.	*Cichorium intybus* L.	Asteraceae	H	TH	Mes	August	September
29.	*Cirsium arvense* (L.) Scop.	Asteraceae	H	TH	Mic	March	May
30.	*Clematis grata* Wall.	Ranunculaceae	S	NP	Mic	August	October
31.	*Clinopodium vulgare* L.	Lamiaceae	H	H	Mic	March	April
32.	*Commelina benghalensis* L.	Commelinaceae	H	TH	Mes	August	September
33.	*Convolvulus arvensis* L.	Convovulaceae	H	G	N	April	June
34.	*Cotoneaster microphyllus*Wall.ExLindl.	Rosaceae	S	NP	L	April	July
35.	*Cuscuta reflexa*Roxb.	Cuscutaceae	H	TH	L	July	August

36.	*Cynodon dactylon*(L.) Pers.	Poaceae	H	G	L	August	December
37.	*Cynoglossum wallichii* G.Don	Boraginaceae	H	TH	Mic	March	June
38.	*Cyperus rotundus*L.	Cyperaceae	H	H	N	May	July
39.	*Daphne mucronata* Royle	Thymelaeaceae	S	NP	N	June	July
40.	*Dicliptera chinensis* (L.) Juss.	Acanthaceae	H	TH	Mic	July	August
41.	*Diospyros lotus* L.	Ebenaceae	T	MP	Mic	Sept	November
42.	*Dodonaea viscosa* (L.) Jacq.	Sapindaceae	S	NP	Mic	May	July
43.	*Dryopteris expansa* (C. Presl) Fraser-Jenk. &Jermy	Dryopteridaceae	H	H	Mes	May	June
44.	*Duchesnea indica* (Jacks.) Focke	Rosaceae	H	H	Mic	March	April
45.	*Elaeagnus latifolia* L.	Elaeagnaceae	S	MP	Mes	March	June
46.	*Equisetum arvense* L.	Equisetaceae	H	G	Mic	March	April
47.	*Erigeron canadensis* L.	Asteraceae	H	TH	Mic	June	August
48.	*Euphorbia helioscopia* L.	Euphorbiaceae	H	MP	Mic	August	October
49.	*Euphorbia heterophylla* L.	Euphorbiaceae	H	TH	Mic	March	April
50.	*Ficus carica* L.	Moraceae	T	TH	N	April	June
51.	*Ficus palmata* Forssk.	Moraceae	T	MP	Mes	March	July
52.	*Foeniculum vulgare* Mill.	Apiaceae	H	TH	Mic	April	July
53.	*Fragaria nubicola* (Lindl. Ex Hook.f.) Lacaita	Rosaceae	H	H	Mic	March	June
54.	*Fumaria indica* (Hausskn.) Pugsley	Papaveraceae	H	TH	N	June	July
55.	*Galinsoga parviflora* Cav.	Asteraceae	H	TH	Mic	March	May
56.	*Galium aparine* L.	Rubiaceae	H	TH	N	June	August
57.	*Geranium rotoundifolium* L.	Geraniaceae	H	G	Mes	June	August
58.	*Geranium wallichinum* D. Don ex Sweet.	Geraniaceae	H	H	Mic	May	August
59.	*Hedera nepalensis* K. Koch	Araliaceae	H	L	Mic	September	November
60.	*Impatiens bicolor* Royle	Balsaminaceae	H	TH	Mes	May	August
61.	*Indigofera heterantha* Brandis	Fabaceae	S	NP	L	June	September
62.	*Inula cappa* (Buch.-Ham. Ex D.Don) DC.	Asteraceae	S	TH	Mic	March	May
63.	*Ipomoea purpurea* (L.) Roth	Convolvulaceae	H	TH	Mes	July	September
64.	*Iris kashmiriana* Baker	Iridaceae	H	G	Mes	April	July
65.	*Isodon rugosus* (Wall.exBenth.) Codd	Lamiaceae	S	NP	Mic	April	September
66.	*Jasminum offcinale*L.	Oleaceae	S	NP	Mic	May	June

67.	*Juglans regia* L.	Juglandaceae	T	NP	Mic	July	August
68.	*Lactucas erriola*L.	Asteraceae	H	H	Mic	July	September
69.	*Lathyrus aphaca* L.	Fabaceae	H	TH	Mic	July	August
70.	*Launaea procumbens* (Roxb.) Ramayya& Rajagopal	Asteraceae	H	CH	Mic	March	May
71.	*Lepidium campestre* (L.) R.Br.	Brassicaceae	H	TH	Mic	March	April
72.	*Lepidium didymium* L.	Brassicaceae	H	TH	Mic	March	April
73.	*Leptopus cordifolius* Decne.	Phyllanthaceae	S	NP	Mic	March	April
74.	*Limonium cabulicum* (Boiss.) Kuntze	Plumbaginaceae	H	NP	Mes	August	October
75.	*Malva parviflora*L.	Malvaceae	H	TH	Mic	May	July
76.	*Medicago polymorpha*L.	Fabaceae	H	TH	N	March	June
77.	*Melia azedarach* L.	Meliaceae	T	TH	N	April	May
78.	*Mentha longifolia* (L.) L.	Lamiaceae	H	H	Mic	August	October
79.	*Mentha piperita* L.	Lamiaceae	H	H	N	June	September
80.	*Micromeria biflora* (Buch.-Ham. Ex D.Don) Benth.	Lamiaceae	H	TH	L	July	August
81.	*Morus alba* L.	Moraceae	T	CH	L	May	June
82.	*Morus nigra* L.	Moraceae	T	MP	Mes	May	June
83.	*Nasturtium officinale* R.Br.	Brassicaceae	H	TH	N	April	May
84.	*Oenothera rosea* L'Hér. Ex Aiton	Onagraceae	H	H	Mic	March	June
85.	*Olea ferruginea* Wall. Ex Aitch.	Oleaceae	T	MP	Mic	March	May
86.	*Onychium contiguum* C.Hope	Adiantaceae	H	G	Mes	June	July
87.	*Origanum vulgare* L.	Lamiaceae	H	H	Mic	June	July
88.	*Oxalis corniculata*L.	Oxalidaceae	H	H	N	May	August
89.	*Parthenium hysterophorus* L.	Asteraceae	H	TH	N	April	May
90.	*Persicaria capitata*(Buch.-Ham. Ex D.Don) H.Gross	Polygonaceae	H	TH	Mic	September	November
91.	*Persicaria hydropiper* (L.) Delarbre	Polygonaceae	H	TH	Mic	September	November
92.	*Phlomis bracteosa* Royle ex Benth.	Lamiaceae	H	G	Mic	July	August
93.	*Pinus roxburghii* Sarg.	Pinaceae	T	MP	N	May	July
94.	*Pinus wallichiana* A.B.Jacks.	Pinaceae	T	MP	N	May	July
95.	*Plantago lanceolate* L.	Plantaginaceae	H	H	Mic	March	July
96.	*Plantago major* L.	Plantaginaceae	H	Th	Mic	March	July
97.	*Platanus orientalis* L.	Platanaceae	T	MP	Mes	April	May

98.	*Polygonum aviculare*L.	Polygonaceae	H	CH	Mic	April	June
99.	*Populus alba* L.	Salicaceae	T	MP	Mic	May	June
100.	*Populus ciliata* Wall. Ex Royle	Salicaceae	T	MP	Mic	April	June
101.	*Prunus armeniaca* L.	Rosaceae	T	MicP	Mes	March	May
102.	*Prunus domestica* L.	Rosaceae	T	MP	Mic	April	May
103.	*Prunus persica* (L.) Batsch	Rosaceae	T	MesP	Mic	April	August
104.	*Pteris cretica*L.	Pteridaceae	H	G	Mes	May	July
105.	*Punica granatum* L.	Lythraceae	T	MP	N	June	August
106.	*Pyrus bourgaeana* Decne.	Rosaceae	T	MesP	Mic	May	June
107.	*Pyrus pashia*Buch.-Ham. Ex D.Don	Rosaceae	T	MP	Mic	April	June
108.	*Quercus incana* Bartram	Fagaceae	T	MesP	Mic	April	July
109.	*Ranunculus arvensis* L.	Ranunculaceae	H	TH	Mic	March	June
110.	*Ranunculus muricatus*L.	Ranunculaceae	H	TH	Mic	April	May
111.	*Robinia pseudoacacia*L.	Papilionaceae	T	MP	N	March	April
112.	*Rosa moschata*Herrm.	Rosaceae	S	MicP	Mes	March	April
113.	*Rosa webbiana*Wall. Ex. Royle	Rosaceae	S	NP	Mic	April	June
114.	*Rubus ellipticus*Sm.	Rosaceae	S	NP	Mes	March	May
115.	*Rubus fruiticosus*L.	Rosaceae	S	NP	Mes	March	May
116.	*Rumex dentatus*L.	Polygonaceae	H	TH	Mes	August	September
117.	*Rumex hastatus*D. Don	Polygonaceae	H	TH	N	April	July
118.	*Sageretia thea*(Osbeck) M.C. Johnst.	Rhamnaceae	S	NP	N	March	April
119.	*Salix alba* L.	Salicaceae	T	MP	Mic	May	September
120.	*Salvia moorcroftiana*Wall. exBenth.	Lamiaceae	H	TH	Mag	July	August
121.	*Sarcococca pruniformis*Lindl.	Buxaceae	S	NP	Mic	March	July
122.	*Scandix pecten-veneris* L.	Apiaceae	H	TH	Mic	March	April
123.	*Senecio chrysanthemoides*DC.	Asteraceae	H	TH	Mic	July	September
124.	*Seseli mucronatum*(Schrenk) Pimenov and Sdobnina	Apiaceae	H	TH	Mic	March	June
125.	*Silene conoidea*L.	Caryophyllaceae	H	TH	N	March	June
126.	*Silybum marianum*(L.) Gaertn.	Asteraceae	H	TH	Mes	March	May
127.	*Solanum nigrum* L.	Solanaceae	H	TH	Mic	March	May
128.	*Solanum pseudocapsicum*L.	Solanaceae	H	TH	Mic	March	May

129.	*Sonchus asper* (L.) Hill	Asteraceae	H	TH	N	April	June
130.	*Stellaria media* (L.) Vill.	Caryophyllaceae	H	TH	L	March	May
131.	*Strobilanthes urticifolia*Wall. Ex Kuntze	Acanthaceae	H	TH	Mic	March	May
132.	*Swertiachirata* (Roxb ex. Fleming) H.Karst	Gentianaceae	H	TH	L	June	August
133.	*Tagetes minuta* L.	Asteraceae	H	CH	Mic	June	August
134.	*Taraxacum officinale* (L.) Weber ex F.H.Wigg	Asteraceae	H	TH	Mic	April	July
135.	*Trifolium repens*L.	Papilionaceae	H	TH	N	May	July
136.	*Tulip aclusiana*DC.	Liliaceae	H	TH	Mic	March	May
137.	*Urtica dioica*L.	Urticaceae	H	TH	Mic	August	September
138.	*Verbascum thapsus*L.	Scrophulariaceae	H	TH	Mes	April	June
139.	*Vicia sativa* L.	Fabaceae	H	TH	N	March	May
140.	*Xanthium strumarium*L.	Asteraceae	H	TH	Mes	June	August
141.	*Zanthoxylum armatum*DC.	Rutaceae	T	NP	Mic	May	July
142.	*Ziziphus jujuba*Mill.	Rhamnaceae	T	MP	Mic	May	June

Abbreviations for Life Form : MP : Megaphanerophytes, MicP : Microphanerophytes, MesP : Mesophanerophytes, NP : Nanophenrophytes, H : Hemicryptophytes, G : Geophytes, CH : Chamaephytes, TH : Therophytes, L : Liana. **Abbreviations for Plant Habit :** H=Herb, S=Shrub, T=Tree.

Table. 2. Life form of different taxa recorded from Agror valley.

S.No	Life Form Classes	No. of Species	Percentage
1	Megaphanerophytes	20	14.08%
2	Mesophanerophytes	05	3.52%
3	Nanophanerophytes	17	11.97%
4	Chamaephytes	04	2.81%
5	Hemicryptophytes	20	14.08%
6	Geophytes	12	8.45%
7	Therophytes	61	42.95%
8	Lianas	01	0.70%

Table 3. Leaf size spectra of different taxa recorded from Agror valley.

S.No	Life spectra classes	Number of plant species	Percentage
1	Leptophylls	10	7.04%
2	Nanophyll	26	18.30%
3	Microphyll	73	51.40%
4	Mesophyll	32	22.53%
5	Megaphyll	1	0.70%

Phenological behaviour

Phenology of the plant species was documented through several visits in research area.

Flowering

The results revealed that two flowering seasons were recorded in the study area, one from May to August and second from September to November (Tables 1 and 4). Mostly plants flowered in the first spell (May to August) during which a total of 137 (96.47%) plant species flowered including herbs 92 (67.15%), trees 28 (20.43%) and shrubs17 (12.40%). During the second flowering season, plant species flowered were 4 (80%) herbs, and 1 (20%) tree. Maximum flowering (42 plant species) occurred in the month of March i.e., the peak month of spring. Further, major flowering months were April, May, June, August, and July where

27, 22, 18, 15 and 13 species showed flowering respectively. On the contrary no flowering was observed during January, February, October, November and December and the most credible cause attributed is low temperature, cold injury, and less metabolic activities.

Fruiting

The phenomenon of fruiting specificly belongs to angiosperms but in broad sense it refers to the formation of cones and sorii etc. In the study area July was the peak fruiting month in which 29 (20.42%) plant species developed fruiting, followed by June 27 (19.01%) plant species, May 24 (16.90%) plant species, August 22 (15.49%) plant species, September 17 (11.97%) plant species while minimum fruiting was produced in the months of April 11 (7.74%) plant species, October 6 (4.22%) plant species, November 5 (3.52%) plant species, followed by December with 1 plant species (0.70%) (Tables 1 and 4). During January, February, and March none of plant species developed fruiting occurred.

Table 4. Flowering sessions of plant species in Agror Valley.

Session	Herbs		Shrubs		Trees	
May-Aug	92	67.15%	17	12.40%	28	20.43%
Sep-Nov	4	80%	0	0	1	20%

Discussion

Phyto diversity of Agror valley

Flora is priceless and valuable endowment of nature to mankind upon which human race has always been dependent. A flora encompasses all the plant individuals in any geographic area, which are attributes of a geological period or in habit a particular ecosystem. The flora comprises several species, while vegetation indicates the distribution, number of plant species and size of each (Durani et al., 2005). More than 0.25 million plant species are recognized, and an enormous number is still to be investigated and documented (Thorne, 1992). Floristic checklists provide most basic, productive, and key botanical information of a particular region. To formulate conservation and management strategies it is imperative to have detailed floristic interpretation of that particular area (Manikandan and Lakshminarasimhan, 2012). The total floral diversity in the study area consisted of 142 plant species belonging to 124 genra and 66 families. The area's physiognomy was dominated by 96 species (67.60%), followed by trees with 29 species (20.42%) and shrubs 17 (11.97%) species. Our findings are in agreement with many researchers of allied, neighboring and national regions (Khattak et al., 2015; S.M. Saeed et al., 2018; Shah et al., 2015; Ahmad et al., 2016 and Rahman et al., 2016b,c).

Family contribution

Asteraceae was the leading family with 17 species followed by Rosaceae 12 species, Lamiaceae 9 species and Polygonaceae 6 species. Flora of the study area displayed strong alliance with neighboring areas on account of families. i.e, in the western Himalayan region Asteraceae, Rosaceae and Poaceae were paramount and leading families (Rau, 1975). Whilst many other researchers such as Mehmood et al., (2015) documented Asteraceae as the dominant family from District Tor Ghar on whose foothills the present research area is located. Saeed et al., (2018) also reported Asteraceae as the leading family with 15 species from Datta, District Mansehra.

Life form spectra

Life form provides indication of the climate and depicts plant -environment interaction (Raunkiaer, 1934). The life form classes were dominated by Therophytes with 61 plant species (42.95%), followed by Megaphanerophytes and Hemicryptophytes with 20 species (14.08%) each. The dominancy of Therophytes indicates the harshness as the huge section of study area is dry subtropical in nature. Such results clearly indicate that flora is severely under pressure due to human activites, over grazing and deforestation. Our results are in accordance with Khan et al. (2013) who stated that therophytes dominated the study area with 40 species followed by Megaphanerophyte with 09 species of all the plants. Similar studies were accomplished by Rahman et al., (2018) from Manoor Valley and documented Therophytic life form as the dominant one.

Leaf size spectra

In present study Microphyll flora was dominanat with 73 species, followed by Mesophylls 32, Nanophylls 26, Leptophylls 10 species and Megaphylls 01 species. The dominancy of microphylls and mesophylls signifies that majority of the area is mesic and has plenteous and temporal distribution of precipitation. Our results are in line with Batalha and Martins (2004) who acknowledged Microphylls and Mesophylls as leading leaf size spectra in the vegetation of Azad Kashmir. Haq et al. (2015) also documented Microphylls and Mesophylls as dominant leaf spectra classes from Nandiar Khuwar Catchment, Battagram.

Conclusion

Exploration of Agror Valley accounted 142 plant species recorded. The study depicted that the area hosts diverse ecological habitat and plant diversity. Vegetation mostly signifies subtropical forest flora, humid ecotone and moist temperate forest vegetation in research area. It was observed that floral diversity varies with seasons and soil composition. The dominancy of Therophytes in study area clearly indicates that a significant proportion is dry subtropical in nature. The ecological attributes such as density, frequency and abundance were highly influenced by anthropogenic pressure. Density and frequency values were at peak in rainy season while were least in cold winter season. It was observed that majority of people are uneducated regarding biodiversity and natural resources. Deforestation of fuel wood and timber wood species, exploitation of medicinal plants and overgrazing is posing serious threats to the biodiversity. The participation of general populace in tree plantation and conserving nature is the need of the hour.

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