Research Paper

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Floristic Composition and Biological Spectrum of Hazarnoe Forest of District Malakand, Khyber Pakhtunkhwa

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Abstract:

The plant species of Hazarnoe Forest of District Malakand, Khyber Pakhtunkhwa, were evaluated floristically from April 2016 to November 2017. Of the total 240 reported plant species, 38 were monocots, 196 dicots which belongs to 85 families and 188 genera respectively. Poaceae was the leading family contributed 20 species. Family Asteraceae contributed (14 spp.), Lamiaceae (13 spp.) while Papilionaceae and Solanaceae each with 10 species. Of the total plant taxa perennials were 161 species compared to annuals (73 spp.) and biennials (06 spp.). The dominant growth form was herbs that contributed (108 spp.) followed by trees (50 spp.) and shrubs (45 spp.) respectively. Phanerophytes were the dominant life-form (92 spp.) whereas leaf size spectrum of microphyll was reported as abundant in the overall floristic. Phanerophytes and microphyll leaf size was the dominant life forms which show typical climate of subtropical region governing the area. Conclusion of study was that the vegetation of the area is under heavy biotic pressure and need proper conservation.

Keywords— Floristic composition; Life form; Leaf size spectrum

INTRODUCTION

Floristic composition is reflection of diversity of vegetation of a specific geographic location and provides a platform to plant species for their correct identification and sustainable utilization (Rafay *et al.*, 2013). For the study of biodiversity, knowledge of floristics of any region play an important role in understanding of the local environment of the area (Thakur *et al.*, 2012). A floristic inventory is a good source of botanical information and provides an appropriate starting point for further comprehensive studies of a specific geographic area (Keith, 1988). So, floristic inventories reflect taxonomic study of a major division of flora in a given area (Panda *et al.*, 2014). Biological spectrum is an index for comparison of widely geographically separated plant communities indicates biotic interaction, habitat and climate deterioration and is used to express the percent distribution of life-forms of a given flora (Raina and Sharma, 2010). The term biological spectrum was proposed by Raunkiaer (1934) which also determine stratification pattern, nature of phytoclimate and layering of a community (Gaza and Raina, 2015). In different regions of the globe, occurrences of similar biological spectrum indicate similar environmental conditions as well as micro and macro climate which govern over the area (Hussain, *et al.*, 2015). Based on similarities in structure, function and ecological conditions plants are classified into life-forms which is the sum of adaptation responses to the pre-dominant climatic conditions. Life forms are important physiognomic attributes that expresses the harmony among plants with its surroundings and used in vegetation studies, after floristic composition (Shimwell, 1971; Warming, 1909). Likewise, leaf size spectrum of a region is useful, for exploring the plant associations with relation to various prevailing climatic factors. Thus, leaf size provides an idea of floristic adaptation and can be helpful in studying vegetation at regional level (Rashid *et al.*, 2011). The aim of this paper is to provide a complete checklist of plant species of the forest area. The study is based on basic aspects of ecology which provides baseline information for conservationists, herbalists and plant biologists.

This paper is organized into the following sections as; Section I explains introductory part of floristic, life form and leaf size spectrum. Section II represents previously related work done and Raunkiaer system of classification. Section III contains field visits, data collection, data analysis and classification of plant species. Section IV describes results and discussion followed by conclusion.

II REVIEW OF LITERATURE AND RAUNKIAER 1934 CLASSIFICATION SYSTEM

Few studies were previously carried out only on ethno-botanical aspects of plant taxa of the Hazarnoe forest by (Murad *et al.*, 2011) who reported the folk medicinal uses of 75 plant species against various

human ailments. (Zabihullah et al., 2006) recorded 82 plant species for different purposes. (Murad et al., 2012) conducted another study on traditional uses of the forest flora, reported 90 plant species of local importance. (Barakat et al., 2011) carried a similar study in nearby hills of forest and recorded a total of 169 plant species used traditionally in preparing medicine, furniture, vegetables and fodder. Zeb et al. [17] al. carried a phytosociological study of the forest and reported 24 weed plants forming various communities.

The Raunkiaer (1934) system is most popular and widely accepted, for classification and description of plant life forms. This system of classification is based, on the position, degree of protection of the perennating buds (Abusaief and Dakhil, 2013). Under this system all types of plants species, can be classified into five major groups. I. Phanerophytes; plants whose perennating buds are near or above 25 cm of the soil surface. II. Therophytes; mostly annuals which complete their life cycle during one season. III. Cryptophytes; plants whose perennating buds are subterranean mostly. IV. Hemicryptophytes; perennating buds of such plant species are at the ground surface and protected by soil and leaves. V. Chamaephytes; perennating buds are below the height of 25 cm and located close to the ground surface (Asad et al., 2015). The forest area lacks such a comprehensive ecological study. Therefore, keeping in mind an inventory of plant species was carried out to report plant species with taxonomic characters.

III FIELD VISIT, DATA COLLECTION AND CLASSIFICATION

A florist survey was carried out during flowering seasons from April 2016 to November 2017 in Hazar Nao forest. The forest is floristically diverse and located almost an altitude of 2727 m above mean sea level between Kot, Agra and Pir Khel village of District Malakand (Zeb et al., 2016) (Fig 1).

Collection of plants were carried out from open sites in foot hills, in understory vegetation at mid and top hills using field instruments like hand pruner. Photographs of plant species were also taken on the spot using a digital camera. Global position system (GPS) was used to record latitude, longitude and aspects of plant species. The plant specimens were sorted, press-dried, preserved, and identified with the help of available literature developed by (Ali and Qaiser, 2007; Nasir, 1994). The specimens of plants were deposited in Herbarium of University of Malakand.

Checklist of the collected plant species were prepared and alphabetically arranged with complete taxonomic description. The plant species were grouped into different life-forms, leaf-size classes followed (Raunkiaer, 1934; Hussain, 1889). Biological spectrum, of the flora was calculated by applying the following formulas.

Life-form spectrum =

$$\frac{\text{Number of species falling in a particular life – form classes}}{\text{Total number of all the species for that community/stand}} \times 100$$

Leaf-size spectrum

$$= \frac{\text{Number of species falling in a particular leaf size classes}}{\text{Total number of all the species for that community/stand}} \times 100$$

Percentiles and Chi-square test was used to interpret the tabulated data. Comparison was made to the life form spectrum of study area flora with Raunkiaer's Normal spectrum. For the result of Chi-square, the following formula was applied following (Zar, 1999).

$\chi^2 = \frac{\sum (E-O)^2}{E}$. E represents the expected values whereas O is the observed values. The sign of sigma denotes that everything that follows is summed.

Figure 1: Show map of study area; (Hazar Noe forest District Malakand).

IV RESULTS AND DISCUSSION

In the current study the total reported plant species were 240 which belong to 118 genera, and 85 families respectively (Table 2). Of them, 196 species were dicotyledons, 38 monocotyledons, one gymnosperm and 05 Pteridophytes respectively. The dominating group was Dicotyledonous plants which were reported by 72 families. Monocotyledons were represented by 09 families followed by Pteridophytes with 03 families whereas Gymnosperms was with 01 family only (Table 1).

Table 1: Taxonomic diversity of plants of Hazarnoe Forest, District Malaknd.

Plants Group	Dicot	Monocot	Pterido-phytes	Gymno-sperm	Total
No. of plant species	196	38	5	1	240
%	82	14	3	1	100
No. of plants Family	72	9	3	1	85
%	85	10	4	1	100

Poaceae was reported being the dominant family in the study area comprised of 20 species. The other plants families such as Asteraceae contributed (14 spp.) followed by Lamiaceae (13 spp.), Papilionaceae and Solanaceae (each with 10 spp.) whereas Rosaceae with (09 spp.) only. In addition, Euphobiaceae and Moraceae contributed, each with (08 spp.) respectively (Fig 2).

Figure 2: Contribution of Plant taxa with five or more than five plant species.

The contribution of families with 05 plant species was Amaranthaceae and Boraginaceae, Cucurbitaceae and Liliaceae, Polygonaceae and Rhamnaceae. The results indicated that Apocynaceae and Brassicaceae, Chenopodiaceae and Convolvulaceae, Cyperaceae and Mimosaceae, Oleaceae and Papaveraceae, Ranunculaceae and Urticaceae, contributed (each 03 spp.) to the overall floristics of the study area whereas Zygophyllaceae shared 04 species only. The remaining families shared either (02 or 01 plant spp.) to the forest flora (Table 2).

Table 2: Taxonomic characteristics of plant species of Hazarnoe Forest, District Malakand

S#	Family/Species Name	Local Name	Habit	Life Span	Life-form	Leaf size	Taxonomic category
1	Acanthaceae						
	<i>Justicia adhatoda</i> L.	Baikar	Shrub	P	NP	Mic	D
2	Alliaceae						
	<i>Allium cepa</i> L.	Piaz	Herb	B	Cr	Mic	M
	<i>Allium sativum</i> L.	Oga	Herb	B	Cr	Mic	M
3	Adiantaceae						
	<i>Adiantum capillus-veneris</i> L.	Sunmbal	Herb	P	Cr	Na	Pt
	<i>Adiantum incisum</i> Forsk.	Sunmbal	Herb	P	Cr	Na	Pt
4	Aizoaceae						
	<i>Portulaca oleracea</i> Linn.	Warkhary	Herb	A	Th	Le	D
5	Amaranthaceae						
	<i>Aervajavanica</i> (Bum.f.)Juss.ex Schult.	Kharboti	Herb	P	Ch	Mic	D
	<i>Achyranthus aspera</i> L.	Speyboti	Herb	P	Th	Mic	D
	<i>Amaranthus caudatus</i> L.	Chalwai	Herb	A	Th	Mes	D
	<i>Amaranthus spinosus</i> L.	Ghano chalwai	Herb	A	Th	Mic	D
	<i>Amaranthus viridis</i> L.	Ghanher	Herb	A	Th	Mic	D
6	Amaryllidaceae						
	<i>Narcissus tazetta</i> L.	Gul-e-nargis	Herb	P	Cr	Mic	M
7	Anacardiaceae						
	<i>Pistacia chinensis</i> Bunge	Shnai	Tree	P	MP	Mic	D
8	Apiaceae						
	<i>Ammi visnaga</i> (L.).Lam	Spaikai	Herb	A	Th	Le	D
9	Apocyanaceae						
	<i>Caralluma fimriata</i> Wall	Pamankai	Herb	P	He	Na	D
	<i>Nerium indicum</i> L.	Gandari	Shrub	P	NP	Mic	D
	<i>Rhazya stricta</i> Decne	Ghandairi	Shrub	P	NP	Mic	D
10	Araceae						
	<i>Acorus calamus</i> L.	Skhawaja	Herb	P	Cr	Mes	M
	<i>Arisaemajacquemontii</i> Blume,Rumphia.	Marjarai	Herb	A	Cr	Mes	M
11	Araliaceae						
	<i>Hedera nepalensis</i> K. Koch, Hort.	Prewatai	Liana	P	NP	Mes	D
	Dendrol						
12	Arecaceae						
	<i>Phoenix dactylifera</i> L.	Kajoor	Tree	P	MP	Mes	M
	<i>Nannorrhops ritchiana</i> Griff	Mayzarai	Shrub	P	NP	Mes	M
13	Asclepiadaceae						
	<i>Calotropis procera</i> (Willd.) R.Br.	Spalmai	Shrub	P	Ch	Mes	D
	<i>Periploca aphylla</i> L.	Barara	Shrub	P	NP	Le	D
14	Asteraceae						
	<i>Artemisia scoparia</i> Waldst & Ket	Jaukai	Herb	P	Ch	Le	D
	<i>Calendula arvensis</i> L.	Ziar gulai	Herb	A	Th	Mic	D
	<i>Carthamus lanatus</i> L.	Kariza	Herb	A	Th	Mic	D
	<i>Carthamus oxycantha</i> Bieb	Kariza	Herb	A	Th	Na	D
	<i>Cichorium intybus</i> L.	Shengulai	Herb	A	Th	Mic	D
	<i>Conyza bonariensis</i> L.	Dhanyabotai	Herb	A	Th	Mic	D
	<i>Echinops echinatus</i> Roxb.	Oantkatara	Herb	A	Ch	Mic	D
	<i>Eryngium biebersteinianum</i> Nervski ex Bobrov	Manzari panja	Shrub	P	Th	Na	D
	<i>Launaea arborescens</i> (Batt.)Murb	Shodapai	Herb	P	Th	Ap	D
	<i>Parthenium hysterophorus</i> L.	Tarkha	Herb	P	Th	Mic	D
	<i>Sonchus asper</i> L.	Shodapai	Herb	A	Th	Mic	D
	<i>Tagetes minuta</i> L.	Hamesha	Herb	A	Th	Mic	D
	<i>Taraxacum officinale</i> L.	Ziargulai	Herb	A	He	Mic	D
	<i>Xanthium strumarium</i> L.	Geshai	Herb	A	Th	Mes	D
15	Berberidaceae						
	<i>Berberis lycium</i> Royle.	Kwarai	Shrub	P	NP	Mic	D
16	Betulaceae						
	<i>Alnus nitida</i> (Spach)Endl	Geyrai	Tree	P	MP	Mes	D
17	Bombacaceae						
	<i>Bombax ceiba</i> L.	Sumbal	Tree	P	MP	Mes	D

18	Boraginaceae						
	<i>Ehretia obtusifolia</i> Hoches	Ghatabotai	Shrub	P	NP	Mic	D
	<i>Ehretia serrata</i> Roxb.	Puran	Tree	P	MP	Mes	D
	<i>Cordia myxa</i> L.	Laswara	Tree	P	MP	Mes	D
	<i>Onosma hispida</i> Wall. Ex G. Don.	Ratanjot	Herb	P	He	Na	D
	<i>Trichodesma indica</i> (L.) R.Br.	Ghwajabai	Herb	A	Ch	Na	D
19	Brassicaceae						
	<i>Lepidium sativum</i> L.	Halam	Herb	A	Th	Na	D
	<i>Capsella bursa pestoris</i> (L.) Medig.	Bimpaisa	Herb	A	Th	Mic	D
	<i>Nasturtium officinale</i> R.Br.	Tarmera	Herb	P	Th	Na	D
20	Buxaceae						
	<i>Buxus wallichiana</i> Baill	Shamshad	Shrub	P	NP	Mic	D
	<i>Sarcococca saligna</i> (D. Don) Muecll	Ladda	Shrub	P	NP	Mic	D
21	Cactaceae						
	<i>Opuntia dilleni</i> (Ker Gawl.) Haw.	Kamala	Herb	P	NP	Ap	D
	<i>Opuntia monacantha</i> (Willd.) Haw.	Zuqam	Shrub	P	NP	Ap	D
22	Caesalpinaceae						
	<i>Bauhinia variegata</i> L.	Kolyar	Tree	P	MP	Mes	D
23	Canabaceae						
	<i>Cannabis sativa</i> L.	Bhang	Herb	B	Th	Mic	D
24	Caryophyllaceae						
	<i>Silene conoidea</i> L.	Mangotai	Herb	A	Th	Na	D
	<i>Stellaria media</i> (L.) Vill	Teghstargai	Herb	A	Th	Le	D
25	Celastraceae						
	<i>Gymnosporia royleana</i> Wall.exLawson	Sorazghai	Shrub	P	NP	Mic	D
26	Chenopodiaceae						
	<i>Chenopodium album</i> L.	Saarmai	Herb	A	Th	Mic	D
	<i>Chenopodium botrys</i> L.	Skhabotai	Herb	P	Hem	Na	D
	<i>Chenopodium ambrosiodes</i> L.	Skhabotai	Shrub	B	Th	Mic	D
27	Convolvulaceae						
	<i>Convolvulus arvensis</i> L.	Prewatai	Climber	A	Th	Mic	D
	<i>Ipomea hedracea</i> L.	Prewatai	Climber	A	Th	Mes	D
	<i>Ipomea pupurea</i> L.	Prewatai	Climber	A	Th	Mes	D
28	Cucurbitaceae						
	<i>Citrullus colocynthnthis</i> (L.)Schrad	Khro Hindwana	Climber	P	Th	Mes	D
	<i>Cucurbita maxima</i> Duch. ex Lam	Kado	Climber	A	Th	Mic	D
	<i>Momordica charantia</i> Linn.	Karela	Climber	A	Th	Mes	D
	<i>Luffa cylindrica</i> (Linn.) Roem	Torai	Climber	A	Th	Mes	D
	<i>Solena amplexicaulis</i> (Lam.) Gandhi	Kakora	Climber	P	Th	Mic	D
29	Cuscutaceae						
	<i>Cuscuta reflexa</i> Roxb.	Marazbotai	Climber	P	Ph	Le	D
30	Cyperaceae						
	<i>Cyprus rotundus</i> L.	Dela	Sedge	P	Cr	Le	M
	<i>Fimbristylis squarrosa</i> Vahl	Barwaz	Sedge	A	Cr	Mic	M
	<i>Hetropogon contortus</i> (L.)	Sormal	Sedge	P	Hem	Mic	M
31	Dryopteridacaea						
	<i>Dryopteris crenata</i> (Forssk.)Kuntz.	Sumbal	Herb	P	Cr	Mic	Pt
	<i>Dryopteris jaxtaposta</i> Christ.	Sumbal	Herb	P	Cr	Mic	Pt
32	Ebenaceae						
	<i>Diospyros lotus</i> Linn.	Tor amlook	Tree	P	MP	Mic	D
	<i>Diospyros kaki</i> Linn.	Ziar amlook	Tree	P	MP	Mes	D
33	Euphorbiaceae						
	<i>Andrachne cordifolia</i> (Wall. exDecne.) Muell.	Krachai	Shrub	P	NP	Mic	D
	<i>Euphorbia granulate</i> Forssk	Warmaga	Herb	P	Hem	Na	D
	<i>Euphorbia helioscopia</i> L.	Mandanro	Herb	A	Th	Na	D
	<i>Euphorbia hirta</i> L.	Paibotai	Herb	A	Th	Na	D
	<i>Euphorbia prostrata</i> L.	Warmaga	Herb	P	Th	Le	D
	<i>Mallotus phillipensis</i> (Lam.) Mucll.	Kambaila	Tree	P	MP	Mes	D
	<i>Phyllanthus emblica</i> L. .	Aamla	Tree	P	Ph	Le	D
	<i>Ricinus comunis</i> L.	Aranda	Shrub	P	NP	Mes	D
34	Equisetaceae						
	<i>Equesetum arvensis</i> L.	Bandakai	Herb	P	Cr	Le	Pt
35	Fagceae						
	<i>Quercus incana</i> Roxb.	Spin banj	Tree	P	MP	Mic	D

36	Flacourtiaceae						
	<i>Flacourtia indica</i> (Berm.) Merrill. .	Katai	Tree	P	NP	Mic	D
37	Fumariaceae						
	<i>Fumaria indica</i> (Hausskn.) H.N.	Papra	Herb	A	Th	Le	D
38	Geraniaceae						
	<i>Geranium Wallichianum</i> D. Don Ex Sweet	Sra zaila	Herb	P	Th	Mic	D
39	Hypericiaceae						
	<i>Hypericum perforatum</i> L.	Shin chai	Herb	P	Th	Le	D
40	Juglandaceae						
	<i>Juglans regia</i> L.	Ghwaz	Tree	P	MP	Mes	D
41	Lamiaceae						
	<i>Ajuga bracteosa</i> Wall. ex. Benth	Gutey	Herb	P	Th	Mic	D
	<i>Ajuga parviflora</i> Benth.	Botey	Herb	P	Th	Mic	D
	<i>Colebrookea oppositifolia</i> Smith.	Banda	Shrub	P	NP	Mic	D
	<i>Micromeria biflora</i> (Buch.-Ham. ex D. Don) Benth.	Nari shamakai	Herb	P	Ch	Le	D
	<i>Mentha longifolia</i> (L.) Huds.	Venalai	Herb	P	Cr	Mic	D
	<i>Mentha spicata</i> L.	Podina	Herb	P	Cr	Mic	D
	<i>Origanum vulgare</i> L.	Shamakai	Herb	P	Ch	Mic	D
	<i>Otostegia limbata</i> (Benth.) Bioss	Spin azghai	Shrub	P	Np	Mic	D
	<i>Plectranthus rogosus</i> Wall. ex Benth	Spaikai	Shrub	P	Np	Mic	D
	<i>Salvia lanata</i> Roxb.	Matarjari	Herb	P	Th	Mic	D
	<i>Salvia moorcroftiana</i> Wall.	Khardag	Herb	P	Ch	Mes	D
	<i>Salvia plebeia</i> R.Br.	Gwarmai	Herb	A	Th	Mic	D
	<i>Teucrium stocksianum</i> Bioss	Khwandabotai	Herb	P	Th	Mic	D
42	Liliaceae						
	<i>Aloe barbadensis</i> Mill.	Kamala	Herb	P	Ch	Mac	M
	<i>Asparagus adscendens</i> L.	Tendonai	Shrub	P	Cr	Le	M
	<i>Asparagus plumosus</i> Baker.	Tendonai	Climber	P	Cr	Le	M
	<i>Asphodelus tenuifolius</i> Cavan	Piazakai	Herb	A	Cr	Mic	M
	<i>Tulipa stellata</i> Hk.f.	Ghantol	Herb	A	Cr	Le	M
43	Lythraceae						
	<i>Woodfordia fruticosa</i> (L.) S. Kurz	Zangalianar	Shrub	P	NP	Mic	D
44	Malvaceae						
	<i>Malva neglecta</i> Wallr.	Panarak	Herb	A	Th	Mic	D
	<i>Abelmoschus esculentus</i> (Linn.) Moench, Meth	Bindai	Herb	A	Th	Mic	D
45	Meliaceae						
	<i>Melia azedarach</i> L.	Bakrana	Tree	P	MP	Mic	D
46	Menispermaceae						
	<i>Tinospora cordifolia</i> Miers	Praiwaterai	Shrub	P	Ph	Mes	D
47	Mimosaceae						
	<i>Acacia modesta</i> Wall	Palusa	Tree	P	MP	Le	D
	<i>Acacia nilotica</i> L.	Kikar	Tree	P	MP	Le	D
	<i>Albizia lebbek</i> (L.) Benth.	Srikh	Tree	P	MP	Le	D
48	Moraceae						
	<i>Ficus benghalensis</i> L.	Rabarbotai	Tree	P	MP	Mes	D
	<i>Ficus carica</i> L.	Inzar	Tree	P	MP	Mac	D
	<i>Ficus palmata</i> Forrsk.	Inzar	Tree	P	MP	Mes	D
	<i>Ficus recemosa</i> L.	Ormal	Tree	P	MP	Mac	D
	<i>Ficus religiosa</i> L.	Peepal	Tree	P	MP	Mes	D
	<i>Ficus foveolata</i> Wall. Ex Miq.	Inzarbotai	Climber	P	He	Mic	D
	<i>Morus alba</i> L.	Spaintoot	Tree	P	MP	Mes	D
	<i>Morus nigra</i> L.	Tortoot	Tree	P	MP	Mes	D
49	Myrsinaceae						
	<i>Myrsine africana</i> L.	Tartarai	Shrub	P	NP	Na	D
50	Myrtaceae						
	<i>Eucalyptus camadulensis</i> L.	Lachi	Tree	P	MP	Mic	D
	<i>Myrtus communis</i> L.	Manro	Shrub	P	NP	Mic	D
51	Nyctaginaceae						
	<i>Boerhavia diffusa</i> L.	Ensai	Herb	A	Th	Mic	D
52	Oleaceae						

	<i>Jasminum humule</i> Linn	Rambail chambail	Shrub	P	NP	Mic	D
	<i>Jasminum officinale</i> L.	Rambail chambail	Shrub	P	NP	Mic	D
	<i>Olea ferruginea</i> Royle	Khona	Tree	P	MP	Mic	D
53	Oxalidaceae						
	<i>Oxalis corniculata</i> L.	Tarokai	Herb	A	Th	Na	D
54	Paeoniaceae						
	<i>Paeonia emodi</i> Wall. ex Royle	Mamaikh	Herb	P	Cr	Mes	D
55	Papaveraceae						
	<i>Papaver pavoninum</i> Schrenk, Enum.	Soregulai	Herb	A	Th	Na	D
	<i>Papaver rhoeas</i> L.	Redaigulai	Herb	A	Th	Mic	D
	<i>Papaver somniferum</i> Linn.	Qashkash	Herb	A	Th	Mic	D
56	Papillionaceae						
	<i>Butea monosperma</i> (Lam.) P. Kuntra	Palai	Tree	P	MP	Mes	D
	<i>Dalbergia sisso</i> Roxb.	Shawa	Tree	P	MP	Mic	D
	<i>Indigofera hetrentha</i> L.	Ghwarija	Shrub	P	NP	Le	D
	<i>Lathyrus aphaca</i> L.	Karkumanai	Climber	A	Th	Na	D
	<i>Lathyrus cicera</i> L.	Marghaikhpa	Climber	A	Th	Na	D
	<i>Lathyrus sativus</i> L.	Chiloe	Climber	A	He	Mic	D
	<i>Lotus corniculatus</i> Linn.	Kasnai	Herb	P	Th	Na	D
	<i>Medicago minima</i> (L.) Gurb	Peshtarai	H	A	He	Na	D
	<i>Robinia pseudocacia</i> L.	Kaikaar	Tree	P	MP	Mic	D
	<i>Vicia sativa</i> L.	Marghaikhpa	Climber	A	Th	Na	D
57	Pinaceae						
	<i>Pinus roxburghii</i> Sergent	Nakhtar	Tree	P	MP	Le	GM
58	Plantaginaceae						
	<i>Plantago lanceolata</i> L.	Jabai	Herb	A	Th	Mic	D
	<i>Plantago major</i> Linn.	Jabai	Herb	A	Th	Mes	D
59	Platanaceae						
	<i>Platanus orientalis</i> L.	Chinar	Tree	P	MP	Mac	D
60	Poaceae						
	<i>Apluda mutica</i> L.	Spenwakhai	Grass	P	Hem	Le	M
	<i>Aristida cyanantha</i> Nees ex Steud.	Mashkeza	Grass	P	Hem	Mic	M
	<i>Arundo donax</i> L.	Nalaan	Herb	P	NP	Mac	M
	<i>Avena sativa</i> L.	Jamdar	Grass	A	Th	Na	M
	<i>Brachiaria ramose</i> (L.) Stapf.	Shamokha	Grass	A	Th	Na	M
	<i>Bromus japonicus</i> Thomes ex murr	Jaukai	Grass	A	Hem	Le	M
	<i>Cenchrus ciliaris</i> L.	Barwaza	Grass	P	Th	Na	M
	<i>Chrysopogon aucheri</i> (Bioss.) Stapf	Spainwakhai	Grass	P	He	Le	M
	<i>Cymbopogon jwarancusa</i> (Jones) Schult	Sirgarai	Grass	P	He	Le	M
	<i>Cynodon dactylon</i> (L.) pers.	Kabal	Grass	P	He	Na	M
	<i>Desmostachya bipinnata</i> (L.) Stapf	Drab	Grass	P	He	Mes	M
	<i>Hordeum murinum</i> L.	Warbashkai	Herb	A	Th	Na	M
	<i>Hordeum vulgare</i> L.	Warbasha	Herb	A	Th	Na	M
	<i>Imperata cylindrical</i> (L.) Beauv.	Pesholakai	Grass	P	He	Le	M
	<i>Dicanthium annulatum</i> (Forsk.) Stapf	Wakha	Grass	P	He	Na	M
	<i>Poa annua</i> L.	Wakha	Grass	A	Th	Na	M
	<i>Saccharum bengalense</i> Retz.	Sharghashe	Grass	P	He	Mes	M
	<i>Saccharum griffithii</i> Munro. Ex Bios.	Bogara	Grass	P	He	Mic	M
	<i>Saccharum spontaneum</i> L.	Kahai	Grass	P	He	Mic	M
	<i>Sorghum helipense</i> (L.) Persoon	Dadum	Grass	P	He	Mic	M
61	Polygonaceae						
	<i>Bistorta amplexicaulis</i> (D. Don) Greenep	Anjabar	Herb	P	Th	Mes	D
	<i>Polygonum aviculare</i> L.	Bandakai	Herb	A	Th	Mic	D
	<i>Polygonum barbatum</i> L.	Pulpholak	Herb	A	Ch	Mic	D
	<i>Rumex dentatus</i> L.	Shalkhai	Herb	A	Th	Mes	D
	<i>Rumex hastatus</i> D. Don	Tarokai	Herb	A	Th	Na	D
62	Primulaceae						
	<i>Anagallis arvensis</i> L.	Gulbotai	Herb	A	Th	Na	D
63	Punicaceae						
	<i>Punica granatum</i> L.	Anangorai	Tree	P	MP	Na	D
64	Ranunculaceae						

	<i>Ranunculus arvensis</i> L.	Ziargulai	Herb	A	Th	Na	D
	<i>Ranunculus muricatus</i> L.	Ziargulai	Herb	A	Th	Mic	D
	<i>Clematis grata</i> Wall.	Zailai	Shrub	P	Cr	Mic	D
65	Rhamnaceae						
	<i>Sageretia thea</i> (Osbeck) M.C. Johnston.	Mumanara	Shrub	P	NP	Na	D
	<i>Ziziphus mauritiana</i> Lam	Baira	Tree	P	MP	Na	D
	<i>Ziziphus numularia</i> (Burm.f) W.&A	Karkanara	Shrub	P	NP	Na	D
	<i>Ziziphus sativa</i> Gaertn.	Markhanai	Tree	P	MP	Na	D
	<i>Ziziphus oxyphyla</i> Edgew.	Enalai	Tree	P	MP	Na	D
66	Rosaceae						
	<i>Cotoneaster nummularia</i> Fischer & C.A. Meyer	Kharawa	Shrub	P	NP	Mic	D
	<i>Duchesnea indica</i> (Andr.) Focke	Zmakitoot	Herb	P	Th	Mic	D
	<i>Fragaria nubicola</i> (Hook.f.) Lindl. ex Lacaita	Mazkitoot	Herb	P	He	Mic	D
	<i>Prunus persica</i> (L.) Batch.	Shaltalu	Tree	P	MP	Mic	D
	<i>Pyrus pashia</i> Hom. Ex.D.	Tango	Tree	P	MP	Mic	D
	<i>Rosa moschata</i> J.Herm	Zangali gulab	Shrub	P	NP	Mic	D
	<i>Rosa Webbiana</i> Wall ex Royle	Pirwarrai	Shrub	P	NP	Mic	D
	<i>Rubus ellipticus</i> Smith.	Karwara	Shrub	P	NP	Mic	D
	<i>Rubus fruticosus</i> L.	Karwara	Shrub	P	NP	Mic	D
67	Rutaceae						
	<i>Zanthoxylum armatum</i> DC. Prodr.	Dambara	Small tree	P	NP	Mic	D
	<i>Skimmia laureola</i> (DC.) Sieb. & Zucc. Ex Walp.	Nazar Panra	Shrub	P	NP	Mic	D
68	Salicaceae						
	<i>Populus nigra</i> L.	Spaida	Tree	P	MP	Mes	D
	<i>Salix babylonica</i> L.	Wala	Tree	P	MP	Mes	D
	<i>Salix alba</i> L.	Wala	Tree	P	MP	Mic	D
	<i>Salix tetrasperma</i> Roxb.	Wala	Tree	P	MP	Mic	D
	<i>Salix acmophylla</i> Boiss.	Wala	Tree	P	MP	Mic	D
69	Sapindaceae						
	<i>Dodonea viscosa</i> (L.) Jacq	Ghwaraskai	Shrub	P	NP	Mic	D
70	Sapotaceae						
	<i>Monothea buxifolia</i> (Falc) A.DC.	Gurgura	Tree	P	MP	Mic	D
71	Scrophulariaceae						
	<i>Verbascum thapsus</i> L.	Kharghwag	Herb	A	Th	Mes	D
72	Simarubaceae						
	<i>Ailanthus altissima</i> (Mill) Swingle.	Shandai	Tree	P	MP	Mic	D
73	Solanaceae						
	<i>Datura innoxia</i> Miller	Bathora	Shrub	P	NP	Mes	D
	<i>Hyoscyamus niger</i> L.	Bargag	Herb	A/B	Th	Na	D
	<i>Lycopersicon esculentum</i> Miller,	Tamatar	Herb	A	Th	Na	D
	<i>Solanum nigrum</i> L.	Kachmachu	Herb	A	Th	Mic	D
	<i>Nicotiana tabacum</i> L.	Cigarette tamaku	Herb	A	Th	Mes	D
	<i>Nicotiana rustica</i> L.	Naswar Tamaku	Herb	A	Th	Mes	D
	<i>Solanum surrattense</i> Burm. F	Maraghonai	Herb	B	Th	Mic	D
	<i>Solanum incanum</i> L.		Shrub	P	Ch	Mes	D
	<i>Withania coagulans</i> (Stocks) Dunal	Spaiara botai	Shrub	P	Ch	Mic	D
	<i>Withania somnifera</i> (L.) Dunal	Kotilaal	Herb	P	Ch	Mes	D
74	Sterculiaceae						
	<i>Helicteres isora</i> L.	Chamyarai	Shrub	P	NP	Mes	D
75	Tamaricaceae						
	<i>Tamarix aphylla</i> (L.) Karst., Deutsche	Ghaz	Tree	P	MP	Le	D
76	Tiliaceae						
	<i>Grewia optiva</i> J.R. Drum.	Pastawoonai	Tree	P	MP	Mic	D
77	Thymeliaceae						
	<i>Daphne mucronata</i> Royle	Laighonai	Shrub	P	NP	Mic	D
78	Typhaceae						
	<i>Typha angustifolia</i> L.	Lokha	Herb	P	Cr	Mes	M
79	Ulmaceae						
	<i>Celtis australis</i> L.	Tagha	Tree	P	MP	Mic	D
	<i>Celtis tetrandra</i> Roxb.	Tawan	Tree	P	MP	Mic	D
80	Urticaceae						

	<i>Debregeasia salicifolia</i> Forssk.	Ajlai	Shrub	P	NP	Mic	D
	<i>Frosskaolea tenacissima</i> Linn.	Staikarbotai	Herb	A	He	Mic	D
	<i>Urtica dioica</i> L.	Sezunkai	Herb	P	Th	Mic	D
81	Verbenaceae						
	<i>Lantana camara</i> L.	Amroodgulai	Shrub	P	Ch	Mic	D
	<i>Vitex negundo</i> L.	Marwandai	Shrub	P	NP	Mic	D
	<i>Verbena officinalis</i> Linn.	Shamakai	Herb	P	He	Mic	D
82	Violaceae						
	<i>Viola canescens</i> wall.ex.Roxb.	Banoesha	Herb	P	He	Mic	D
	<i>Viola betonicifolia</i> Sm.	Banoesha	Herb	P	He	Mic	D
	<i>Viola odorata</i> L.	Banoesha	Herb	A	He	Mic	D
83	Vitaceae						
	<i>Vitis jacquemontii</i> R. Parker.	Gedarkwar	Climber	P	MP	Mes	D
84	Zingiberaceae						
	<i>Curcuma longa</i> Linn.	Karkuman	Herb	P	Cr	Mes	M
	<i>Zingiber officinale</i> L.	Adrak	Herb	P	Cr	Mic	M
85	Zygophyllaceae						
	<i>Fagonia cretica</i> L.	Azghakai	Herb	A	Th	Na	D
	<i>Fagonia olivieri</i> DC.,	Azghakai	Herb	A	Th	Na	D
	<i>Peganum harmala</i> Linn.	Speylane	Herb	A	He	Le	D
	<i>Tribulus terrestris</i> L.	Malkundai	Herb	A	Th	Na	D

Key: A = Annual, B = Biennial, P = Perennial, M = Monocot, D = Dicot, Pt = Pteridiophyte, Gm = Gymnosperm, MP = Mesophanerophyte, NP = Nanophanerophyte, Th = Therophyte, He = Hemicryptophyte, Cr = Cryptophyte, Mac = Macrophyll, Mes = Mesophyll, Mic = Microphyll, Na = Nanophyll, Le = Leptophyll, Ap = Aphyllous

Recently a study conducted by (Hussain et al., 2013) suggested Poaceae being the dominant family was followed by Asteraceae, and Lamiaceae. In another study carried out by (Yemeni and Sher, 2010) reported that Asteraceae, the leading family followed by Poaceae, and Lamiaceae strongly support our present results. Several other researchers (Qureshi et al., 2014; Ilyas et al., 2013; Qureshi et al., 2011) also reported Poaceae as the leading family contributed about 22 and 30 plant species respectively. Therefore, closely support our findings. Perennial growth form was reported the leading life span shared 67% species followed by annuals (37 %.) Conversely, the biennials growth forms were found to be lesser than 10% of the total flora (Fig 3).

Figure 3: Shows relative proportions of plant species of the study area.

Based on habit herbs were reported the common class comprised of 45% species followed by 21% species of trees and 19% species of shrubs respectively. Additionally, climbers and grasses were found to be contributed 7% species each as compared to sedges with 1% species only (Fig 4).

Figure 4: Morphological diversity of plants of Hazanoe forest.

According to (Cain, 1950) life form is an important part of vegetation studies next to floristic composition which is characterized by adaptation of plants to certain environmental conditions. Moreover, the spectrum of life-form indicates climatic and human disturbances, in a particular area and also shows the ecological amplitude, and tolerance of the species (Cain, 1959; Durrani, et al., 2010). Based on composition of life forms and biological spectrum, Phanerophytes were reported as the leading life form class comprised of (38% spp.). Out of them Meso-phanerohytes contributed (20% spp.) followed by Nano-phanerophytes (18% spp). After Phanerophytes, the second largest life form class was Therophytes which contributed 34% plant species. However, the contribution of Hemicryptophyte was 12% and Cryptophyte 10% which were comparatively higher than Chamaephytes 6% plant species (Table 3).

Table 3: Comparison of observed life-form spectrum of forest flora with Raunkiear (1934) spectrum.

Raunkiear spectrum (1934) for 400 species		Observed life-form spectrum of Hazar noe forest for 240 plant Species		χ^2
Therophytes	13%	Therophytes	34%	34
Phanerophytes	46%	Phanerophytes	39%	1.06
Chamaephytes	9%	Chamaephytes	6%	1.00
Hemicryptophytes	26%	Hemicryptophytes	12%	7.5
Cryptophytes	6%	Cryptophytes	10%	2.6
Total	100		100	46.19

In addition, comparisons were made between the life form spectrums of plant species of study sites with normal Raunkiaers (1934) spectrum. This technique was developed for the world flora, which accounts for similar climatic conditions. The χ^2 test showed significant differences between the Raunkiaer's spectrums

($\chi^2 = 46.19$, $p \leq 0.001$) to the forest flora. Therophytes were reported with the highest individual values (34%) obtained from χ^2 test and showed high deviation from the Raunkiaers spectrum (Table 3).

The findings of (Mendes et al., 2010) suggested somewhat similar result of χ^2 test for the flora of Brazil, who also reported significantly a difference of (45.20%) between Raunkiaers spectrum to the study area flora with high proportion of Phanerophyte. Consequently, support strongly our present results. However, deviations from Raunkiaers spectrum were due to difference in phyto-geographical and climatic region. According to (Homji, 1964) life form reveals the phyto-climate of an area, in intensively cultivated and arid region the phyto-climate is of therophytic type while in humid regions the climate is Phanerophytic type, in temperate, high altitudinal arctic regions the climate is Chamaephytic type. In studies carried out by (Kambhar and Kotresha, 2012), they reported therophyte as prevailing life form followed by Phanerophyte and cryptophyte, which suggested that the climate was of Thero-Phanerophytic and indicated dry and hot climate. Such environmental conditions emerged as a response to the harsh climate, overgrazing and deforestation (Sher et al., 2014). Likewise, therophyte dominance in area under study suggested high biotic and anthropogenic pressure. However, Phanerophytes contributed as second largest dominant species suggest us that the forest area has immense potential to grow indigenous medicinal plant species i.e. *Butea monosperma*, *Pistachia integerrima*, *Phyrus pashia*, *Ficus sarmentosa*, *Pinus roxburghii* and *Olea ferruginea*.

According to (Floret et al., 1990) the relationship between leaf size and ecological factors not only play an important role but also helpful in vegetation studies at regional level. The leaf size spectrum of forest plant species was analyzed, microphyll was found to be the leading leaf size class consisted of (112 spp.) followed by mesophyll (48 spp.), and nanophyll (44 spp.) respectively. Whereas lepto-phyll contributed (28 spp.), macro-phyll (05 spp.) and A-phyllous (03 spp.) (Fig 5). The studies conducted by [36] suggested that leaf size increases with increasing soil fertility, precipitation and humidity and but tend to decrease with increase in elevation and irradiance. The mid-elevation area of forest was dominated by meso-phyll and notophylls, while the tree-line forest area was dominated by micro-phylls. The plant species with smaller leaf size in our study area were *Acacia modesta*, *Artemisia scoparia*, *Monotheabuxifolia*, *Euphorbia prostrata*, *Otoestigia limbata*, *Bioss*, *Rumex hastatus*, *Cmybopogon jwarancusa*, showed that the slope is dry; its precipitation retention is in lesser amounts and is characteristics of subtropical climate (Tareen, 1993). Conversely the presence of meso-phyll plant species like *Bauhinia variegata*, *Hedera nepalensis*, *Mallotus phillipensis*, *Ficus* spp, *Butea monosperma*, *Quercus incana*, *Tinosporia cordifolia* suggested humid to pre-humid moisture regimes of the forest. In addition, the foothills of the forest were

afforested with Eucalyptus species which add oil rich litter and consequently affect germination of indigenous medicinal plant species (Hussain, 2002).

CONCLUSION

In our current studies microphyll and mesophyll being the prevailing leaf size class suggested that the forest receives a significant amount of precipitation, hold highest individual value for Phanero-phytes. Likewise, therophyte being the leading life form revealed that the ecological condition of forest is disturbing, due to anthropogenic pressure which is high and need proper management. Moreover, the study in question embraces with rich florist diversity and is under heavy biotic and anthropogenic pressure i.e. deforestation, overgrazing and forest fire. Factors like excessive uprooting of medicinally important plant species by inexperienced, untrained local people results extinction of the rich floristic diversity. There is a dire need for proper identification of local taxa to conserve the biodiversity of the forest area.

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