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., 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 phytoclimmate 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 bysoil 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 Distrit 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 =
Number of species falling in a particular life-form classes \[ \frac{\text{Leaf-size spectrum}}{\text{Total number of all the species for that community/stand}} \times 100 \]

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 | Pteridophytes | Gymnosperm | 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.](image)

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).
| S# | Family/Species Name | Local Name | Habit | Life Span | Life-form | Leaf size | Taxonomic category |
|----|---------------------|------------|-------|-----------|-----------|-----------|-------------------|
| 1  | Acanthaceae         |            |       |           |           |           |                   |
|    | Justicia adhatoda L. | Baikar     | Shrub | P         | NP        | Mic      | D                 |
| 2  | Alliaceae           |            |       |           |           |           |                   |
|    | Allium cepa L.      | Piaz       | Herb  | B         | Cr        | Mic      | M                 |
|    | Allium sativum L.   | Oga        | Herb  | B         | Cr        | Mic      | M                 |
| 3  | Adiantaceae         |            |       |           |           |           |                   |
|    | Adiantum capillus-veneris L. | Sunnbal | Herb | P | Cr       | Na       | Pt                |
|    | Adiantum incisum Forsk, | Sunnbal | Herb | P | Cr       | Na       | Pt                |
| 4  | Aizoaceae           |            |       |           |           |           |                   |
|    | Portulaca oleracea Linn. | Warkhary | Herb | A | Th       | Le       | D                 |
| 5  | Amaranthaceae       |            |       |           |           |           |                   |
|    | Aerva javanica (Bum.f.)Juss.ex Schult. | Kharboti | Herb | P | Ch       | Mic      | D                 |
|    | Achyranthes aspera L. | Speyboti | Herb | P | Th       | Mic      | D                 |
|    | Amaranthus caudatus L. | Chalwai | Herb | A | Th       | Mes      | D                 |
|    | Amaranthus spinosus L. | Ghano chalwai | Herb | A | Th       | Mic      | D                 |
|    | Amaranthus viridis L | Ghanher    | Herb | A | Th       | Mic      | D                 |
| 6  | Amarillidiaceae     |            |       |           |           |           |                   |
|    | Narcissus tazetza L. | Gul-e-nargis | Herb | P | Cr       | Mic      | M                 |
| 7  | Anacardiaceae       |            |       |           |           |           |                   |
|    | Pistacia chinensis Bunge | Shnai     | Tree  | P | MP       | Mic      | D                 |
| 8  | Apiceae             |            |       |           |           |           |                   |
|    | Ammi visnaga (L.)Lam | Spaikai    | Herb  | A | Th       | Le       | D                 |
| 9  | Apocyanaceae        |            |       |           |           |           |                   |
|    | Caralluma fimbriata Wall | Pamankai | Herb | P | He       | Na       | D                 |
|    | Nerium indicum L.   | Gandari    | Shrub  | P | NP       | Mic      | D                 |
|    | Rhaza stricta Decne | Ghandairi  | Shrub  | P | NP       | Mic      | D                 |
| 10 | Araceae             |            |       |           |           |           |                   |
|    | Acorus calamus L.   | Skhawaja   | Herb  | P | Cr       | Mes      | M                 |
|    | Arisaemajacquemontii Blume, Rumphia. | Marjarai | Herb | A | Cr       | Mes      | M                 |
| 11 | Arallaceae          |            |       |           |           |           |                   |
|    | Hedera nepalensis K. Koch, Hort. | Prewatai | Liana | P | NP       | Mes      | D                 |
|    | Dendrol             |            |       |           |           |           |                   |
| 12 | Areaceae            |            |       |           |           |           |                   |
|    | Phoenix dactylifera L. | Kajoor     | Tree  | P | MP       | Mes      | M                 |
|    | Nannorrhops ritchiana Griff | Mayzarai | Shrub | P | NP       | Mes      | M                 |
| 13 | Asclepiadaceae      |            |       |           |           |           |                   |
|    | Calotropis procera (Willd.) R.Br. | Spalmai | Shrub | P | Ch       | Mes      | D                 |
|    | Periploca aphylla L. | Barara     | Shrub  | P | NP       | Le       | D                 |
| 14 | Asteraceae          |            |       |           |           |           |                   |
|    | Artemisia scoparia Waldst & Ket | Jaukai | Herb | P | Ch       | Le       | D                 |
|    | Calendula arvensis L. | Ziar gulai | Herb | A | Th       | Mic      | D                 |
|    | Carthamus lanatus L. | Kariza     | Herb  | A | Th       | Mic      | D                 |
|    | Carthamus oxyacantha Bieb | Kariza | Herb | A | Th       | Na       | D                 |
|    | Cichorium intybus L. | Shengulai  | Herb  | A | Th       | Mic      | D                 |
|    | Conyza bonariensis L. | Dhanayobotai | Herb | A | Th       | Mic      | D                 |
|    | Echinops echinatus Roxb. | Oantkatara | Herb | A | Ch       | Mic      | D                 |
|    | Eringium biebersteinianum Nervski ex Bobrov | Manzari panja | Shrub | P | Th       | Na       | D                 |
| 15 | Berberidaceae       |            |       |           |           |           |                   |
|    | Berberis lycoicus Royke. | Kwarai | Shrub | P | NP       | Mic      | D                 |
| 16 | Betulaceae          |            |       |           |           |           |                   |
|    | Alnus nitida (Spach)Endl | Geyrai | Tree  | P | MP       | Mes      | D                 |
| 17 | Bombacaceae         |            |       |           |           |           |                   |
|    | Bombax ceiba L.     | Sumbal     | Tree  | P | MP       | Mes      | D                 |
| 18 | Boraginaceae |
|----|-------------|
| Ehretia obtusifolia Hoehes | Ghatabotai | Shrub | P | NP | Mic | D |
| Ehretia serrata Roxb. | Puran | Tree | P | MP | Mes | D |
| Cordia myxa L. | Laswara | Tree | P | MP | Mes | D |
| Onosma hispida Wall. Ex G. Don. | Ratanjot | Herb | P | He | Na | D |
| Trichodesma indica (L.) R.Br. | Ghwajabai | Herb | A | Ch | Na | D |
| 19 | Brassicaceae |
| Lepidium sativum L. | Halam | Herb | A | Th | Na | D |
| Capsella bursa pastoris (L). Medig. | Bimpaisa | Herb | A | Th | Mic | D |
| Nasturtium officinale R.Br. | Tarmera | Herb | P | Th | Na | D |
| 20 | Buxaceae |
| Buxus wallichiana Baill | Shamshad | Shrub | P | NP | Mic | D |
| Sarcoococca saligna (D. Don) Mueell | Ladda | Shrub | P | NP | Mic | D |
| 21 | Cactaceae |
| Opuntia dilleni(Ker Gawl.) Haw. | Kamala | Herb | P | NP | Ap | D |
| Opuntia monacantha (Wild.) Haw. | Zuqam | Shrub | P | NP | Ap | D |
| 22 | Caesalpinaceae |
| Bauhinia variegata L. | Kolyar | Tree | P | MP | Mes | D |
| 23 | Canabaceae |
| Cannabis sativa L. | Bhang | Herb | B | Th | Mic | D |
| 24 | Caryophyllaceae |
| Silene conoidea L. | Mangotai | Herb | A | Th | Na | D |
| Stellaria media (L.) Vill | Teghstargai | Herb | A | Th | Le | D |
| 25 | Celastraceae |
| Gymnosporia royleana Wall.exLawson | Sorazghai | Shrub | P | NP | Mic | D |
| 26 | Chenopodiaceae |
| Chenopodium album L. | Saarmai | Herb | A | Th | Mic | D |
| Chenopodium botrys L. | Skhabotai | Herb | P | Hem | Na | D |
| Chenopodium amphibloides L. | Skhabotai | Shrub | B | Th | Mic | D |
| 27 | Convolvulaceae |
| Convolvulus arvensis L. | Prewatai | Climber | A | Th | Mic | D |
| Ipomea hederaea L. | Prewatai | Climber | A | Th | Mes | D |
| Ipomea pulpurea L. | Prewatai | Climber | A | Th | Mes | D |
| 28 | Cucurbitaceae |
| Citrullus colocynthis (L.)Schrad | Khro Hindwana | Climber | P | Th | Mes | D |
| Cucurbita maxima Duch. ex Lam | Kado | Climber | A | Th | Mic | D |
| Momordica charantia Linn. | Karela | Climber | A | Th | Mes | D |
| Luffa Cylindrica (Linn.) Roem | Torai | Climber | A | Th | Mes | D |
| Solena amplexicaulis (Lam.) Gandhi | Kakora | Climber | P | Th | Mic | D |
| 29 | Cuscataea |
| Cuscata reflexa Roxb. | Marazbotai | Climber | P | Ph | Le | D |
| 30 | Cyperaceae |
| Cyperus rotundusL | Dela | Sedge | P | Cr | Le | M |
| Filbristylis squarrosa Vahl | Barwaz | Sedge | A | Cr | Mic | M |
| Heteropogon contortus (L.) | Sormal | Sedge | P | Hem | Mic | M |
| 31 | Dryopteridaceae |
| Dryopteris crenata (Forssk.)Kuntz. | Sumbal | Herb | P | Cr | Mic | Pt |
| Dryopteris jasmapodiata Christ. | Sumbal | Herb | P | Cr | Mic | Pt |
| 32 | Ebenaceae |
| Diospyros lotus Linn. | Tor amlook | Tree | P | MP | Mic | D |
| Diospyros kakiLinn. | Ziar amlook | Tree | P | MP | Mes | D |
| 33 | Euphorbiaceae |
| Andracne cordifolia (Wall. exDecne.) | Krachai | Shrub | P | NP | Mic | D |
| Euphorbia granulata Forssk | Warmaga | Herb | P | Hem | Na | D |
| Euphorbia helioscopia L. | Mandarro | Herb | A | Th | Na | D |
| Euphorbia hirta L. | Pabotai | Herb | A | Th | Na | D |
| Euphorbia prostrata L. | Warmaga | Herb | P | Th | Le | D |
| Mallotus philippensis (Lam.) Mucll. | Kambaila | Tree | P | MP | Mes | D |
| Phyllanthus emblica L. . | Aamla | Tree | P | Ph | Le | D |
| Ricinus communis L. | Aranda | Shrub | P | NP | Mes | D |
| 34 | Equisetaceae |
| Equisetum arvensis L. | Bandakai | Herb | P | Cr | Le | Pt |
| 35 | Fagaceae |
| Quercus incana Roxb. | Spin banj | Tree | P | MP | Mic | D |
|   | Family          | Species Name                               | Common Name | Type     | P | NP | Mic | D |
|---|----------------|--------------------------------------------|-------------|----------|---|----|-----|---|
| 36| Flacourtiaeae | *Flacouria indica* (Berm.) Merill.  | Katali      | Tree     |   |    | NP  |   |
| 37| Fumariaceae   | *Fumaria indica* (Hausskn.) H.N.          | Papra       | Herb     | A |    | Th  | Le |
| 38| Geraniaceae   | *Geranium Wallichianum* D. Don Ex Sweet   | Sra zaila   | Herb     | P |    | Th  | Mic |
| 39| Hyperiaceae   | *Hypericum perforatum* L.                 | Shin chai   | Herb     | P |    | Th  | Le |
| 40| Juglandaeae   | *Juglans regia* L.                        | Ghwaz       | Tree     |   |    | MP  | Mes |
| 41| Lamiaeae      | *Ajuga bracteosa* Wall. ex Benth.         | Gutey       | Herb     | P |    | Th  | Mic |
|    |                | *Ajuga purpurea* Benth.                   | Botey       | Herb     | P |    | Th  | Mic |
|    |                | *Colebrokia oppositifolia* Smith.         | Banda       | Shrub    | P |    | NP  | Mic |
|    |                | *Micromeria biflora* (Buch.-Ham. ex D. Don) Benth. | Nari shakamai | Herb  | P |    | Ch  | Le |
|    |                | *Meniga longifolia* (L.)Huds.             | Venalai     | Herb     | P |    | Cr  | Mic |
|    |                | *Meniga spicata* L.                       | Podina      | Herb     | P |    | Cr  | Mic |
|    |                | *Oriyanum vulgare* L.                     | Shamakai    | Herb     | P |    | Ch  | Mic |
|    |                | *Otostegia limbata* (Benth.) Bioss        | Spin azghai | Shrub    | P |    | Np  | Mic |
|    |                | *Plectranthus rosogus* Wall.ex Benth.     | Spakai      | Shrub    | P |    | Np  | Mic |
|    |                | *Salvia lanata* Roxb.                     | Matarjari   | Herb     | P |    | Th  | Mic |
|    |                | *Salvia moorecroftiana* Wall.             | Khardag     | Herb     | P |    | Ch  | Mes |
|    |                | *Salvia plebeia* R.Br.                    | Gwarmai     | Herb     | A |    | Th  | Mic |
|    |                | *Teucrium stockstanum* Bioss              | Khamdabota  | Herb     | P |    | Th  | Mic |
| 42| Liliaceae      | *Aloe barbadensis* Mill.                  | Kamala      | Herb     | P |    | Ch  | Mac |
|    |                | *Asparagus adscendens* L.                 | Tendonai    | Shrub    | P |    | Cr  | Le |
|    |                | *Asparagus plumosus*Baker.                | Tendonai    | Climber  | P |    | Cr  | Le |
|    |                | *Asphodelus tenuifolius* Cavan            | Piazakai    | Herb     | A |    | Cr  | Mic |
|    |                | *Tulipa stellata* Hk.f.                   | Ghantol     | Herb     | A |    | Cr  | Le |
| 43| Lythraceae     | *Woodfordia fruticosa* (L.) S. Kurz       | Zangalianar | Shrub    | P |    | NP  | Mic |
| 44| Malvaeae       | *Malva neglecta* Wallr.                   | Panerak     | Herb     | A |    | Th  | Mic |
|    |                | *Abelmoschus esculentus*(Linn.)           | Bindai      | Herb     | A |    | Th  | Mic |
|    |                | *Moench, Meht*                           |            |          |   |    |     |    |
| 45| Meliaeae       | *Melia azedarach* L.                      | Bakrana     | Tree     | P |    | MP  | Mic |
| 46| Menispermacae | *Tinospora cordifolia* Miers              | Praiwatai   | Shrub    | P |    | Ph  | Mes |
| 47| Mimosaceae     | *Acacia modesta* Wall                    | Palusa      | Tree     | P |    | MP  | Le |
|    |                | *Acacia nilotica* L.                      | Kikar       | Tree     | P |    | MP  | Le |
|    |                | *Albizia lebbeck* (L.)Benth.              | Srikh       | Tree     | P |    | MP  | Le |
| 48| Moraceae       | *Ficus benghalensis* L.                   | Rabbarotai  | Tree     | P |    | MP  | Mes |
|    |                | *Ficus carica* L.                        | Inzar       | Tree     | P |    | MP  | Mac |
|    |                | *Ficus palma* Forrsk.                    | Inzar       | Tree     | P |    | MP  | Mes |
|    |                | *Ficus recemosa* L.                      | Ormal       | Tree     | P |    | MP  | Mac |
|    |                | *Ficus religiosa* L.                     | Peepal      | Tree     | P |    | MP  | Mes |
|    |                | *Ficus foveolata* Wall. Ex Miq.           | Inzarbotai  | Climber  | P |    | He  | Mic |
|    |                | *Morus alba* L.                          | Spaintoot   | Tree     | P |    | MP  | Mes |
|    |                | *Morus nigra* L.                         | Tortoot     | Tree     | P |    | MP  | Mes |
| 49| Myrsinaceae    | *Myrsine africana* L.                     | Tartara     | Shrub    | P |    | NP  | Na |
| 50| Myrtaceae      | *Eucalyptus camadulensis* L.              | Lachi       | Tree     | P |    | MP  | Mic |
|    |                | *Myrtus communis* L.                      | Manro       | Shrub    | P |    | NP  | Mic |
| 51| Nyctaginaceae  | *Boerhavia diffusa* L.                    | Ensat       | Herb     | A |    | Th  | Mic |
| 52| Oleaceae       |                                           |             |          |   |    |     |    |
### 53 Oxalidaceae
- Oxalis corniculata L.: Tarokai, Herb, A, Th, Na, D

### 54 Papaveraceae
- Papaver somniferum L.: Quashkash, Herb, A, Th, Mic, D

### 55 Papaveraceae
- Papaver paeoniflorum Schenk., Enum.: Soreghulai, Herb, A, Th, Na, D
- Papaver rhoas L.: Redaigulai, Herb, A, Th, Mic, D

### 56 Papilionaceae
- Butea monosperma (Lam.) P. Kuntra: Palai, Tree, P, MP, Mes, D
- Daucus carota L.: Shawa, Tree, P, MP, Mic, D
- Indigofera heterantha L.: Gharwarija, Shrub, P, NP, Le, D
- Lathyrus aphanes L.: Karkunanai, Climber, A, Th, Na, D
- Lathyrus cicera L.: Marghaikpa, Climber, A, Th, Na, D
- Lathyrus sativus L.: Chiloe, Climber, A, He, Mic, D
- Lotus corniculatus Linn.: Kasnai, Herb, P, Th, Na, D
- Medicago minima (L.) Gurb: Peshtarai, H, A, He, Na, D
- Robinia pseudoacacia L.: Kaikar, Tree, P, MP, Mic, D
- Viciea sativa L.: Marghaikpa, Climber, A, Th, Na, D

### 57 Pinaceae
- Pinus roxburghii Sergent: Nakhtar, Tree, P, MP, Le, GM

### 58 Plantaginaceae
- Plantago lanceolata L.: Jabai, Herb, A, Th, Mic, D
- Plantago major Linn.: Jabai, Herb, A, Th, Mes, D

### 59 Platanaceae
- Platanus orientalis L.: Chinar, Tree, P, MP, Mac, D

### 60 Poaceae
- Apluda mutica L.: Spenwakhai, Grass, P, Hem, Le, M
- Aristida cymosana Nees ex Steud.: Mashkeza, Grass, P, Hem, Mic, M
- Arundo donax L.: Nalaan, Herb, P, NP, Mac, M
- Avena sativa L.: Jamdar, Grass, A, Th, Na, M
- Bracharia ramose (L.) Stapf.: Shamokha, Grass, A, Th, Na, M
- Bromus japonicus Thomas ex murr: Jaukai, Grass, A, Hem, Le, M
- Chenopodium ciliaris L.: Barwaza, Grass, P, Th, Na, M
- Cynodon dactylon (L.) pers.: Srinagar, Grass, P, He, Le, M
- Desmostachya bipinnata(L.L)Stapf: Drab, Grass, P, He, Mes, M
- Hordeum murinum L.: Warbashkai, Herb, A, Th, Na, M
- Hordeum vulgare L.: Warbasha, Herb, A, Th, Na, M
- Imperata cylindrica (L.) Beauv.: Pesholakai, Grass, P, He, Le, M
- Dicotylis annulatum(Forsk.)Stapf: Wakha, Grass, P, He, Na, M
- Poa annua L.: Wakha, Grass, A, Th, Na, M
- Saccharum bengalense Retz.: Shargashe, Grass, P, He, Mes, M
- Saccharum griffithii Munro.Ex Bios.: Bogara, Grass, P, He, Mic, M
- Saccharum spontaneum L.: Kahai, Grass, P, He, Mic, M
- Sorghum helipense (L.)Persoon: Dadum, Grass, P, He, Mic, M

### 61 Polygonaceae
- Bistorta amplexicaulis (D.Don) Greenep: Anajabar, Herb, P, Th, Mes, D
- Polygonum aviculare L.: Bandakai, Herb, A, Th, Mic, D
- Polygonum barbatum L.: Pulpohak, Herb, A, Ch, Mic, D
- Rumex dentatus L.: Shalkhai, Herb, A, Th, Mes, D
- Rumex hastatus D.Don: Tarokai, Herb, A, Th, Na, D

### 62 Primulaceae
- Anagallis arvensis L.: Gulbotai, Herb, A, Th, Na, D

### 63 Punicaceae
- Punica granatum L.: Anangorai, Tree, P, MP, Na, D

### 64 Ranunculaceae
| Genus                                      | Scientific Name                      | Common Name | Type | Part Used | Medicinal Properties |
|--------------------------------------------|--------------------------------------|-------------|------|----------|----------------------|
| *Ranunculus arvensis* L.                   | Ziaargulai                           | Herb        | A    | Th       | Na                   | D                |
| *Ranunculus muricatus* L.                  | Ziaargulai                           | Herb        | A    | Th       | Mic                  | D                |
| *Clematus grata* Wall.                     | Zialai                               | Shrub       | P    | Cr       | Mic                  | D                |
| 65 **Rhamnaceae**                          |                                      |             |      |          |                      |                  |
| *Sageretia thea* (Osbeck) M.C. Johnston.  | Mumanara                             | Shrub       | P    | NP       | Na                   | D                |
| *Ziziphus mauritian* Lam.                  | Baira                                | Tree        | P    | MP       | Na                   | D                |
| *Ziziphus numularia* (Burn.f) W.&A         | Karkanara                            | Shrub       | P    | NP       | Na                   | D                |
| *Ziziphus sativa* Gaerth.                  | Markhanai                            | Tree        | P    | MP       | Na                   | D                |
| *Ziziphus oxyphylla* Edgew.                | Enalai                               | Tree        | P    | MP       | Na                   | D                |
| 66 **Rosaceae**                            |                                      |             |      |          |                      |                  |
| *Cotoneaster numularia* Fischer & C.A. Meyer| Kharawa                             | Shrub       | P    | NP       | Mic                  | D                |
| *Duchesnea indica* (Andr.) Focke            | Zmakitoor                            | Herb        | P    | Th       | Mic                  | D                |
| *Fragaria nubicola* (Hook.f.) Lindl. ex Lacaita | Mazkitoot                        | Herb        | P    | He       | Mic                  | D                |
| *Pruus persica* (L.) Batch.                 | Shaltala                             | Tree        | P    | MP       | Mic                  | D                |
| *Pyrus pashia* Hom. Ex.D.                  | Tango                                | Tree        | P    | MP       | Mic                  | D                |
| *Rosa moschatula* Herm.                    | Zangali gulab                        | Shrub       | P    | NP       | Mic                  | D                |
| *Rosa Webbiana* Wall ex Royle              | Pirwarrai                            | Shrub       | P    | NP       | Mic                  | D                |
| *Rubus ellipticus* Smith.                  | Karwara                              | Shrub       | P    | NP       | Mic                  | D                |
| *Rubus fruticosus* L.                      | Karwara                              | Shrub       | P    | NP       | Mic                  | D                |
| 67 **Rutaceae**                            |                                      |             |      |          |                      |                  |
| *Zanthoxylum armatum* DC. Prodr.           | Dambara                              | Small tree  | P    | NP       | Mic                  | D                |
| *Skimnia laureola* (DC.) Sieb. & Zucc. Ex Walp. | Nazar Panra                      | Shrub       | P    | NP       | Mic                  | D                |
| 68 **Salicaceae**                          |                                      |             |      |          |                      |                  |
| *Populus nigra* L.                         | Spaidha                              | Tree        | P    | MP       | Mes                  | D                |
| *Salix babylonica* L.                      | Wala                                 | Tree        | P    | MP       | Mes                  | D                |
| *Salix alba* L.                            | Wala                                 | Tree        | P    | MP       | Mic                  | D                |
| *Salix tetrasperma* Roxb.                  | Wala                                 | Tree        | P    | MP       | Mic                  | D                |
| *Salix acmophylla* Boiss.                  | Wala                                 | Tree        | P    | MP       | Mic                  | D                |
| 69 **Sapindaceae**                         |                                      |             |      |          |                      |                  |
| *Dodonea viscosa* (L.) Jacqa               | Ghwaraskai                           | Shrub       | P    | NP       | Mic                  | D                |
| 70 **Sapotaceae**                          |                                      |             |      |          |                      |                  |
| *Monotheca buxifolia* (Falc.) A.D.C.        | Gurgura                              | Tree        | P    | MP       | Mic                  | D                |
| 71 **Scrophulariaceae**                     |                                      |             |      |          |                      |                  |
| *Verbascum thapsus* L.                     | Kharghwag                            | Herb        | A    | Th       | Mes                  | D                |
| 72 **Simarubaceae**                        |                                      |             |      |          |                      |                  |
| *Allanthus altissima* (Mill) swingle.       | Shandai                              | Tree        | P    | MP       | Mic                  | D                |
| 73 **Solanaeae**                           |                                      |             |      |          |                      |                  |
| *Datura innoxia* Miller                    | Bathora                              | Shrub       | P    | NP       | Mes                  | D                |
| *Hyoscyamus niger* L.                      | Bargag                               | Herb        | A    | B        | Th                   | Na               |
| *Lycopersicon esculentum* Miller, L.        | Tamatar                              | Herb        | A    | Th       | Na                   | D                |
| *Solanum nigrum* L.                        | Kachmachu                            | Herb        | A    | Th       | Mic                  | D                |
| *Nicotiana tabacum* L.                     | Cigarette tamakui                    | Herb        | A    | Th       | Mes                  | D                |
| *Nicotiana rustica* L.                     | Naswar Tamakui                       | Herb        | A    | Th       | Mes                  | D                |
| *Solanum surrattense* Burm. F               | Maraghonai                           | Herb        | B    | Th       | Mic                  | D                |
| *Solanum incanum* L.                       | Shrubb                               | Ch          | Mes   |          |                      |                  |
| *Withania coagulans* (Stocks) Dunal         | Spaiara botai                        | Shrub       | P    | Ch       | Mic                  | D                |
| *Withania somnifera* (L.Dunal)              | Kotilaal                             | Herb        | P    | Ch       | Mes                  | D                |
| 74 **Sterculiaceae**                       |                                      |             |      |          |                      |                  |
| *Helicteres isora* L.                      | Chamyarai                            | Shrub       | P    | NP       | Mes                  | D                |
| 75 **Tamaricaceae**                        |                                      |             |      |          |                      |                  |
| *Tamarix apiflora* (L.) Karst.,Deutsche     | Ghaz                                 | Tree        | P    | MP       | Le                   | D                |
| 76 **Tiliaceae**                           |                                      |             |      |          |                      |                  |
| *Grewia optiva* J.R. Drum.                 | Pastawoonai                          | Tree        | P    | MP       | Mic                  | D                |
| 77 **Thymelaeaceae**                       |                                      |             |      |          |                      |                  |
| *Daphne macronata* Royle                   | Laighonai                            | Shrub       | P    | NP       | Mic                  | D                |
| 78 **Typhaceae**                           |                                      |             |      |          |                      |                  |
| *Typha angustifolia* L.                    | Lokha                                | Herb        | P    | Cr       | Mes                  | M                |
| 79 **Ulmaceae**                            |                                      |             |      |          |                      |                  |
| *Celtis australis* L.                      | Tagha                                | Tree        | P    | NP       | Mic                  | D                |
| *Celtis tetrandra* Roxb.                   | Tawan                                | Tree        | P    | NP       | Mic                  | D                |
| 80 **Urticaceae**                          |                                      |             |      |          |                      |                  |
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.](image)

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 Hazano 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-phanerophytes 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 Hazano forest for 240 plant Species | χ² |
|------------------------------------------|---------------------------------------------------------------|-----|
| 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                                |                                                              | 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 χ² test showed significant differences between the Raunkiaer’s spectrums
(χ^2 = 46.19, p ≤ 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. An 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 Phenerophyte and crytophyte, 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, Monothecabuxifolia, Euphorbia prostrata, Otoestigia limbita, Bioss, Rumex hastatus, Cmyhobogen 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 philipensis, Ficus spp, Butea monosperma, Quercus incana, Tinospora 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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