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Phytoecological evaluation with detail floristic appraisal of the vegetation arround Malam Jabba, Swat, Pakistan

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ABSTRACT

Objective: To determine the present status of plant communities and their possible association with the habitat in Malam Jabba, Swat, Pakistan. **Methods:** A study on the phytoecology was conducted in various ecologically important sites of Malam Jabba, Swat, Pakistan from 2002 to 2004. The altitude of these sites ranged from 1 200 m to 3 200 m. Quadrat method was used for evaluation of plants communities and the data on these attributes was converted to relative values. The plant communities were named after 3 leading species with highest importance values. Biological spectrum of the flora based on the life form was prepared by following Raunkiar's life form classes. **Results:** The floristic composition and structure of the study area were found to be 200 species belonging to 75 families. Asteraceae, Lamiaceae and Poaceae were important families in the study area. The biological spectrum showed that therophytic and hemicrytophytic life form and micro-nonophyllous leaf sizes were dominant in the area. The air and soil temperatures were decreasing with increasing elevation. Both the air and soil temperatures were relatively higher in south slopes than on the northeast slopes. The vegetation analysis of the area indicated eleven plant communities around the area. The present vegetation is the relics of moist temperate coniferous forest in the area. The communities reflect highly deteriorated conditions. Both the structure and composition of the surrounding vegetation were associated with the types of habitats. **Conclusions:** The conservation of the remaining populations of the reported communities will be best achieved by proper time of sustainable harvesting. It is only possible with the participation of local communities.

1. Introduction

The studied valley is bounded by district Shanglapar in the North-East, district Buner in the South-West and by main Swat River and road in the West. The area is situated between 35 ° -20′ to 35 ° -45′ N Latitudes and 72 ° -12′ to 73 ° -32′ E Longitudes. The altitude (above sea level) of the valley varies from 1 200 meters at the valley entrance to 3 200 meters at the highest peak of Shagar Sar.

Population of the valley is about 40 000 people with a density of 200 persons per sq km, and a growth rate of 3.4[1]. The region is mountainous with one peak, Shagar Sar, measuring more than 3 200 meters in altitude. It occupies the floristically rich southern extension of Hindu Kush Raj of the Hindu Kush mountain range.

Owing to the intensive use of forest resources and the heavy exploitation of their natural habitats a number of plants has become rare and sparse and it has thus been necessary to monitor the effects of habitat loss (due to deforestation, grazing, terrace cultivation), overharvesting and altitude (low, medium and high) on the population status of different plant communities[2, 3]. The evaluation of changes in ecological conditions often occurs on the basis of vegetation monitoring. Vegetation is a reflection of the existing environmental conditions of an area. The study helps predicting the future management programe of the forests. The present preliminary study, therefore, was undertaken to report the present status of plant communities and their possible association with the habitat.

2. Materials and methods

2.1. Floristic composition

The study area was surveyed every month for three consecutive years, *i.e.* 2002 to 2004. Throughout the field visits, general collections of plants were made. The plants were put in newspapers and a presser was used for the preservation of specimen. The newspapers were being

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changed from time to time and the dried specimens were mounted on standard herbarium sheets (12″×18″) with adhesive tap. Naphthalene powder was sprinkled to protect the plants specimens from microbial attack. Species were identified with the help of available literature[4-6]. The nomenclature was confirmed at Pakistan Museum of Natural History, Islamabad and Herbarium Department of Botany, Government College University Lahore. A complete floristic list along with families was compiled. Plants were assigned to various Raunkiaerin life form and leaf size classes[7].

Raunkiaerin approach explains and helps in understanding the flora and structure of vegetation in relation to prevailing eco-biological conditions. For example an undisturbed forest would look some what different from its degraded counterpart. In this context it also reflects the impact of current biotic factors, like overgrazing, overharvesting, deforestation on the overall vegetation structure and composition. It also influences the economic value of plants in various ways. The approach is useful in determining the population status of targeted plants in mix plant communities.

Biological spectrum of the flora based on the life form was prepared by following Raunkiar's[7] life form classes as follows: (1) Therophytes: Annual seed bearing plants which complete their life cycle in one year and over winter the unfavourable season by means of seeds or spores. (2) geophytes: Perennating buds located below the surface of soil including plants with deep rhizomes, bulbs, tubers and corms *etc*. (3) hydrophytes: Submerged hydrophytes and those rooted in the muddy substratum. The above ground or upper parts die at the end of growing season. (4) hemicrytophytes: Herbaceous perennial in which aerial portion of plant dies at the end of growing season, leaving a perennating bud at or just beneath the ground surface. (5) chamaeophytes: Perennating buds located close to the ground surface (below the height of 25 cm). They include herbaceous, low woody trailing, low stem succulents and cushion plants. (6) phanerophytes: They are shrubby and tree species whose perennating buds are borne on aerial shoot reaching a height of at least 25cm or more above the ground surface. These include:

a) Megaphanerophytes (Mg) 30 meters tall or above
b) Mesophanerophytes (Mp) 7.5 to 30 meters tall
c) Nanophanerophytes (Np) 0.25 to 7.5 meters tall

After having assigned a life form to all the plants Raunkiarian spectra was calculated as follows:

$$\text{Biological spectra} = \frac{\text{No. of species falling in a particular life form classes}}{\text{Total number of all the species for that community/stand}} \times 100$$

Plants were classified into Raunkiarian leaf sizes as follows[7]:

1.Leptophyll Leaf area up to 25 sq.mm
2.Nanophyll Leaf area 25 to 225 sq.mm
3.Microphyll Leaf area 225 to 2025 sq.mm
4.Mesophyll Leaf area 2025 to 18225 sq.mm
5.Macrophyll Leaf area 18225 to 164025 sq.mm
6.Megaphyll Leaf area larger than 164025 sq.mm

Raunkiaer spectrum was calculated as follows:

$$\text{Leaf size spectra} = \frac{\text{No. of species falling in a particular leaf size classes}}{\text{Total number of all the species for that community/stand}} \times 100$$

2.2. Sampling procedure

After a preliminary survey of the study area, 10 representative sites were targeted on the basis of physiognomic contrast, altitude, habitat, species composition and stages of degradation (deforestation, grazing, overharvesting and erosion).

The south and north-east facing slopes is distinct in the Malam Jabba hills. The general vegetation data in these two slopes was collected at five altitudinal zone *viz*., 1500 m (foot hill), 1900 m-2300 m (mid hills) 2700 m, and 3200 m (top hill). Herbs, shrubs and trees were sampled in twenty (10 ×1) m^2, fifteen (2×4) m^2 and ten (10×5) m^2 squares respectively for density, frequency and herbage coverage. The data on these phytosociological attributes was converted to relative values and these added together gave importance value (IV) for each of the recorded species. The communities were named after 3 leading species which has the highest IVs[2, 8]. The squares were laid randomly in a nested manner. From the fixed point, after every 200 meters, to four directions on the determined angles, square of plots were laid. In this way the whole site was sampled. Tally counter was used for counting steps and where necessary for counting plants.

2.3. Soil analysis

Two soil samples per site have been collected from each site upto a depth of 5 cm. And then they were air dried and analyzed in the Soil Laboratory of the Agricultural Research Farm Tarnab, Peshawar by using standard methods of Jackson[9]. The results were documented. Air and soil temperature were also determined by using air and soil thermometers. Additionally, some other physical environmental parameters, such as altitude, aspect, latitude, longitude, inclination, *etc*. were recorded for each major plot. The colour of the soil was noted on the spot.

3. Results

3.1. Soil analysis

The colour of soils at different altitudes and aspects varied from grey-brownish at 1500 m to grey-blackish at 1900 m, 2300 m and 2700 m and grey at 3200 m, in both the northeast and southern aspects of each elevational level. Similarly, the texture of soil varied from loamy sand or sandy clay, and loamy silt to sandy clay loam. Soils were non saline with moderate to slightly alkaline reaction in the southern aspects and to slight acidic reaction in the northeastern aspects. The litter contents varied from 10% to 12% on the southern aspects and from 13% to 17% in the northeastern aspects, which was mostly depended on the state of erosion and canopy layer. The pH, electrical conductivity and total soluble salts did not vary much among the slopes, aspects and sites. The water holding capacity was maximum (varied from 20.45% to 33.33%) in the northeastern aspects with organic matter of 1.62 to 1.91 and was comparatively minimum (varied from 8.0% to 22.32%) in the southern aspects with organic matter of 1.3 to 1.9.

Nitrogen contents varied from 0.2% to 0.9%, with variations from 86 ppm (1500 m southern) to 226 ppm (1500 m northeastern). On the other hand, the phosphorus contents varied from as low as 2.1 ppm (northeast, 1900 m) to 7.4 ppm (southern, 2700 m). Ca and Mg contents varied from 2.91% to 3.71% in the southern aspects and from 2.41% to 3.17% in the northeastern aspects. Chloride contents were slightly higher in the northeastern aspects (varied from 1.6 to 1.8 meq/L) in contrast to the southern aspects (varied from 1.3 to 1.4 meq/L). The water holding capacity, organic matter, N, P,

and K, Ca, Mg and Chloride contents exhibited significant differences in both protected and unprotected sites located at the elevation of 1900 m. While the soil of cultivation plots was comparatively more fertile than the soil of the natural sites. The results showed that the air and soil temperatures were slightly higher on the south facing slopes as compared to the northeast facing slopes. Similarly, the air and soil temperature of protected area was slightly lower than unprotected sites located at the same altitude. Moreover, in both the cases, there was a gradual decrease in temperature with rising altitude.

3.2. Floristic composition

The floristic list of the study area comprised 200 species belonging to 75 families. It included 65 dicots, 4 monocots, 2 gymnosperms and 2 pteridophytes while bryophytes and fungi were represented each by one family. Asteraceae (19 spp.), Lamiaceae (13 spp.) and Poaceae (11 spp.) were the most represented families. These were followed by Papilionaceae (10 spp.), Rosaceae (9 spp.), Ranunculaceae (7 spp.) and Apiaceae (3 spp.). The remaining families had one or two species. Among these, there were 126 herbs, 32 shrubs, 28 trees and 14 grass species in the area.

3.3. Biological spectra

According to the Raunkiaerian life form therophytes (39.5%) were dominant in the area. hemicryptophytes and geophytes were the next dominant with an over all representation of 17% and 12.5% respectively. Chaemophytes 7.5%, mesophanerophytes 7%, megaphanerophytes 4%, nanophaneorophytes 4% and climbers 1.5% had share in the area. While hydrophytes, and parasites had one or less than one percent contribution in the establishment of vegetation in the study area.

In leaf size spectra, Raunkiaerian approach also revealed that microphylls (41.5%) dominanted the study area. They were followed by nanophylls (32%), leptophylls (13.5%), mesophylls (12%), macrophylls (7%) and megaphylls (3%) respectively.

3.4. Plant community structure

Vegetation of the study area varied due to tremendous changes in the altitude, climate and aspect. There were eleven plant communities and the existence of these communities, themselves being the result of interactions of physical and biotic factors within habitats. The species having the IV less than one have insignificant contribution in the establishment of plant community/stand in a particular region.

Following were the details of these eleven plant communities:

3.3.1. Plectranthus – Themeda – Cynodon community (PTC)

This community consisting of 45 species is present on south facing slopes at an elevation of 1500 m (Table 1). It was dominated by *Cynodon dactylon* (*C. dactylon*), *Plectranthus rugosus* (*P. rugosus*), *Themeda anthera* with IV of 37.02, 22.03 and 22.01 respectively. The remaining 42 species were the common associate of the community (Table 1). This community was under heavy biotic pressure which had almost removed the top layer.

3.3.2. Cynodon – Oxalis – Plectranthus community (COP)

This community was found on the northern slopes at an elevation of 1500 m, consisting of 34 plant species. *C. dactylon* was dominat species (IV=48.01) followed by *Oxalis corniculata* (IV=24.01) and *P. rugosus* (IV=22.01). The remaining 31 species had low IV in the community as associate of this community. This community was also subjected to immense biotic pressure.

3.4.3. Artemisia – Cynodon – Berberis community (ACB)

This community harbours southern slopes at an altitude of 1900 m, and comprises of 34 plant species. The dominant species was *Artemisia scoparia* followed by *C. dactylon* and *Berberis lycium* (*B. lycium*)with IVs of 60.90, 40.10 and 35.12 respectively. The remaining 31 species were the associated components of the community. This community was under heavy grazing and human pressure, as a result the valuable plant species had low IV (Table 1).

3.4.4. Viburnum – Fragaria – Viola community (VFV)

This community comprising 38 species is established on the north facing slopes at an elevation of 1900 m. *Viburnum nervosum* (IV=38.21), *Fragaria vesca* (IV=32.06) and *Viola serpens* (*V. serpens*) (IV=28.2) were the dominant members of this community. *Persicaria amplexicaule* (*P. amplexicaule*), *Pinus wallichiana* (*P. wallichiana*) and *Picea smithiana* (*P. smithiana*) with IV of 27.01, 25.1 and 24.1 respectively were the co-dominant associates of this community. *Valeriana jatamansi* (*V. jatamansi*) with IV 11.2 had insignificant association with the community (Table 1). Heavy grazing, deforestation and over harvesting had adversely affected the ecological status of the community.

3.4.5. Persicaria – Pinus – Viola community (PVV)

This community was recognized in the protected site of the study at an altitude of 1900 m in the north facing slopes. *P. amplexicaule*, *P. wallichiana* and *V. serpens* were the leading dominant species with IV of 78.12, 75.08 and 67.01 respectively. This community was associated by 53 plant species, in which *V. jatamansi* was the co-dominant species (Table 1). The site was protected from collection, grazing and cutting, which favoured high species diversity in contrast to other communities and supported the establishment of *Persicaria*, *Pinus* and *Viola* Community.

3.4.6. Sibbaldia– Achillea – Senecio community (SAS)

This community consists of 31 species and is present on the southern slopes at an elevation of 2300 m. This is a highly degraded community and dominated by non-palatable species like *Sibbaldia cuneata* (*S. cuneata*), *Achillea millifolium* and *Senecio chrysanthemoides*. Their IVs were 48.01, 39.23 and 34.41 respectively (Table 1). Heavy grazing, deforestation and terrace cultivation had levelled the plants to the ground. The associated elements were non to less palatable. There were ample bare spaces with stony soil. The original vegetation degraded to ground flora which still has scattered woody elements.

3.4.7. Viola – Viburnum – Pinus community (VVP)

This community consisting of 38 species is established on the north facing slopes at an elevation of 2300 m. The dominant members were *V. serpens* (IV=57.21), *V. nervosum* (IV=43.14) and *P. wallichiana* (IV=27.21). *P. smithiana* and *C. dactylon* with IVs of 25.11 and 21.12 were the co-dominant elements of this community. The remaining 27 associated species had low IVs in this community (Table 1). This community was also subjected to indiscriminate uses by the inhabitants of the study valley.

3.4.8. Indigofera – Cynodon – Berberis community (ICB)

This community comprising of 31 species is established

Table 1
IV of various plant communities at different altitudes of south and north-east facing slopes of Malam Jabba, during 2002-2004.

Species	1500 m		1900 m		2300 m		2700 m		3200 m		Protected site (1900 m)
	S	NE	S	NE	S	NE	S	NE	S	NE	NE
	PTC	COP	ACB	VFV	SAS	VVP	ICB	VPP	AAP	APA	PPV
Abies pindrow Royle.	–	–	–	15.6	17.1	35.4	18.1	27.1	30.7	41.4	4.2
Achillea millifolium L.	–	–	–	–	16.2	39.2	17.6	9.1	33.0	22.9	2.3
Achyranthus aspera L.	–	2.5	6.9	–	–	–	–	–	–	–	11.7
Adiantum capillus-veneris L.	1.7	4.6	2.5	–	–	17.5	–	–	29.8	49.1	13.2
A. incisum L.	2.0	–	–	7.7	15.3	9.2	–	6.1	1.2	4.1	15.2
Adonis aestivalis L.	3.0	–	3.0	–	–	–	–	–	–	–	4.
Ajuga bracteosa Wall.	8.3	–	16.1	–	9.3	–	–	–	–	–	1.0
Ailanthus altissima (Mill) Swingle.	2.5	–	4.3	–	–	–	–	–	–	–	4.5
Alnus nitida L.	6.8	7.7	–	4.1	–	–	–	–	–	–	–
Amaranthus spinosa L.	–	2.8	–	–	–	–	–	–	–	–	7.8
A. viridis L.	3.7	2.0	–	1.0	–	–	–	–	–	–	5.6
Anthroxon prionodes Steud.	–	–	–	–	–	10.1	–	9.1	4.6	13.1	2.1
Arnebia linearifolia L.	–	4.1	11.1	–	–	–	–	3.1	11.9	9.2	–
Artemisia maritima L.	–	6.3	16.0	–	–	5.1	–	–	7.2	–	9.6
A. scopara Waldst.	4.1	–	60.9	–	–	–	–	–	–	–	–
A. vulgare L.	11.1	–	–	–	–	4.1	–	–	–	–	–
Asparagus gracilis Roya L.	6.1	–	–	–	–	–	–	–	4.1	7.9	–
Berberis lycium Royal	13.1	2.2	35.1	–	–	4.7	–	28.4	3.1	–	–
Bergenia ciliata Boriss.	–	–	–	–	7.1	11.3	–	14.1	18.3	4.1	10.8
Buxus sempervirens Hk. F.	–	5.3	10.1	–	–	–	6.7	–	13.1	10.1	15.7
Cannabis sativa L.	2.0	–	–	–	–	–	–	–	–	–	3.2
Caesalpinia decapitata (Lamb) D.Don.	6.3	5.1	–	11.1	–	–	–	–	–	–	4.6
Celtis caucasica L.	5.1	–	–	–	–	–	–	–	–	–	–
Cenchrus pennisetiformis Hochest. Steud.	7.1	–	5.7	–	–	–	–	–	–	–	–
Cetrach dalhossiae (Hoker) C. Chr.	2.3	–	–	24.1	–	–	3.2	–	–	–	–
Chenopodium botrys L.	2.1	–	–	–	–	–	–	–	–	–	3.4
Chrysopogon montanus Trin.	–	21.2	–	24.1	37.0	23.1	–	15.0	–	–	–
Contoneaster microphylla Wall.	–	–	10.1	–	–	–	4.6	–	7.8	11.8	7.1
Cuscuta reflexa Roxb.	7.0	–	10.4	4.2	–	–	–	–	–	–	10.1
C. dactylon (L.) Pers.	22.1	48.1	40.1	–	–	11.1	21.1	37.3	12.1	–	–
Cynoglossum lanceolatum Forssk.	3.1	–	10.1	–	–	–	–	–	–	–	8.9
Convolvvlus arvensis L.	–	–	–	19.6	–	–	–	–	3.1	–	–
Dicanthium annulatum Forssk Stapf.	–	10.1	22.1	–	–	–	–	–	–	–	–
Diospyros lotus L.	14.1	–	–	–	–	–	–	–	–	–	–
Dioscorea deltoidea L.	–	–	–	–	–	6.0	14.2	14.1	10.9	11.1	–
Dryopteris juxtapostia Christ.	–	–	–	–	–	11.0	–	–	15.6	14.1	9.1
Elaeagnus angustifolia L.	9.0	–	–	3.4	–	–	–	–	–	–	1.2
Euphorbia prostrate Ait.	14.1	–	17.1	–	–	–	–	–	–	–	–
Euphorbia wallichii L.	–	–	–	–	–	6.0	14.1	14.1	10.9	11.1	–
Ficus carica L.	15.3	–	16.2	–	–	–	–	–	–	–	7.8
Fragaria vesca Lind L.	–	18.1	–	32.0	35.3	–	4.22	21.1	37.8	–	12.1
Galium tetraphyleum L.	6.32	–	–	–	–	–	–	–	14.1	4.6	–
G.aparina L.	–	–	2.3		8.0	12.7	6.1		5.6	3.4	2.3
Hypericum perforatum L.	–	–	–	19.6	7.9	11.1	23.0	–	11.9	–	3.9
H.oblongifolium L.	–	–	–	2.2	6.1	5.1	4.5	–	3.2	9.3	8.9
Hyoscymus niger L.	–	–	–	–	–	–	0.6	–	–	–	–
Indigofera herterantha var herterantha (Wall. ex. Backer) Ali.	–	6.2	7.2	3.2	21.1	21.0	–	24.2	1.1	–	14.7
Jasminum humile L.	–	–	–	6.7	–	–	–	–	–	–	–
J. officinalis L.	4.7	–	–	–	–	–	–	–	–	–	–
Juniperus communis L.	–	–	–	–	–	–	–	–	8.0	18.7	–
Medicago polymorpha L.	8.07	8.1	11.1	–	13.4	–	–	–	–	–	20.1
M. lupulina L.	–	5.12	–	–	–	–	–	–	8.2	5.6	–
Morus alba L.	19.3	–	–	–	–	–	–	–	–	–	–
M. nigra L.	–	18.2	–	–	–	–	–	–	–	–	–
Myrsine africana L.	2.3	4.7	–	–	–	–	–	–	–	–	–

Species	1500 m		1900 m		2300 m		2700 m		3200 m		Protected site (1900 m)
	S	NE	S	NE	S	NE	S	NE	S	NE	NE
	PTC	COP	ACB	VFV	SAS	VVP	ICB	VPP	AAP	APA	PPV
Nasturtium officinale L.	–	7.21	–	15.1	–	8.3	–	–	4.6	–	–
Nepeta govaniana (Bth) Bth.	–	3.41	–	–	6.0	–	5.01	–	–	–	11.6
Olea ferruginea Royle. (Shrub)	–	–	8.9	5.0	6.7	–	–	–	–	–	–
Oxalis corniculata L.	6.6	24.1	–	–	14.2	–	–	–	6.3	–	7.8
Paeonia emodi L.	–	–	–	–	–	11.0	28.1	26.0	13.9	11.9	–
Parrotiopsis jacquemontiana L.	–	–	–	16.1	2.77	8.0	–	–	15.6	9.8	–
Persicaria amplexicaule D. Don.	9.1	10.1	16.1	27.1	27.1	27.9	17.6	48.7	59.2	4.0	78.1
Picea smithiana (Wall)Boiss.	–	10.3	–	24.1	–	46.1	25.7	37.1	89.1	42.3	3.2
Pinus roxburghii Song.	4.7	1.1	–	–	–	–	–	–	–	–	–
Pinus wallichiana L.	–	3.3	–	25.1	74.9	8.7	27.2	7.12	78.1	18.2	75.1
Plectranthus rugosus Wall.	37.2	22.1	60.9	–	16.1	–	–	–	–	–	4.2
Plantago lanceolata L.	–	–	17.2	8.09	–	–	–	8.91	–	–	3.7
P. major L.	4.0	7.4	–	–	–	–	–	–	–	–	2.7
Populus alba L.	–	–	4.6	–	8.0	–	–	–	–	–	–
P. nigra L.	3.1	–	1.2	–	–	–	–	–	–	–	–
Podophyllum hexandrum L.	–	–	–	–	–	–	7.0	9.2	10.7	12.1	–
Primula macrophylla D. Don.	–	–	–	–	–	–	2.01	5.01	6.1	3.03	–
Pteris vittata L.	–	–	–	7.78	27.7	14.7	–	10.1	3.0	4.6	–
Quercus incana Lindi ex. Rogle.	–	12.1	–	13.2	–	–	–	4.9	4.0	–	13.2
Q.dilitata L.	–	–	–	–	–	4.6	–	–	–	–	–
Ranunculus equatalis L.	–	–	–	3.24	–	–	8.0	–	–	6.8	14.1
R.muricatus L.	–	–	5.47	–	–	–	–	–	–	–	5.7
Rosa moschata L.	15.3	–	–	11.2	14.7	–	16.2	–	–	–	3.4
R. webbenia L.	–	–	–	11.2	–	–	16.2	5.8	3.1	–	1.2
Rumex hastatus D. Don.	14.6	–	–	–	16.8	–	–	3.1	–	2.1	10.1
R.nepalensis L.	16.3	–	7.3	4.64	–	8.32	–	19.3	11.9	4.1	15.1
Salix spp.	–	–	–	–	–	–	17.3	30.1	4.1	14.0	–
Salvia moorcroftiana Wall ex. Bth.	11.1	–	16.3	–	–	4.1	–	–	–	–	3.2
Sarcocoa saligna Wall ex. Bth.	–	–	3.4	–	5.1	–	7.8	–	–	–	10.1
Senecio chrysanthemoides DC.	–	3.4	–	–	–	34.4	–	13.7	–	–	4.1
Sedum adentricus Wall.	–	–	–	–	–	3.8	–	4.0	–	5.1	–
Sibbaldia cuneata Cunze.	–	–	–	–	9.0	48.1	40.7	44.3	99.9	86.2	–
Skimmea laureola DC.	–	–	–	–	–	–	–	2.0	–	5.0	–
Solanum nigrum L.	6.3	4.2	–	3.8	–	–	–	–	–	–	6.5
Spiraea lindleyana Wall.	–	–	–	6.4	–	–	–	2.9	8.9	–	13.1
Stipa siberica L. Lank.	–	–	–	17.4	7.6	12.1	–	6.27	–	–	–
Swertia alate (D. Don) C. B Clarke.	–	–	–	–	5.3	–	6.81	–	7.8	2.2	–
Taxus wallichiana (L) Roxb.	–	–	–	–	–	–	–	16.9	7.0	12.2	–
Thalictrum pedunculatum Edgew.	–	–	–	–	5.01	–	–	6.07	–	1.1	–
Themeda anathera nees. ex. Steud.) Mull. Arg.	22.1	–	24.4	–	–	23.2	–	–	–	–	–
Urtica pilulifera L.	–	–	–	8.5	–	6.1	–	11.6	11.8	5.2	3.2
U. dioica L.	10.1	–	14.9	–	13.1	–	–	–	–	3.1	7.8
Verbascum thapsus L.	–	5.0	–	7.1	–	–	–	–	–	–	1.2
Viburnum nervosum D. Don.	–	–	–	38.1	–	24.2	43.1	21.1	–	–	–
Valeriana jatamansi Jones.	–	–	–	11.2	41	75.8	26.1	87.1	23.2	58.3	65.6
Viola serpens Wall. Ex. Roxb.	2.1	27.2	–	21.2	47	67.1	57.2	11.2	17.7	79.7	67.0
Zanthoxyllum armatum L.	–	–	2.1	5.0	–	–	–	–	–	–	9.1
Zizyphus sativa Geartn.	14.1	–	–	3.1	–	–	–	–	–	–	–
Z.Jujuba Edgew.	9.1	–	4.6	–	–	–	–	–	–	–	–

Key:
PTC= *Plectranthus – Themeda – Cynodon* community
COP= *Cynodon – Oxalis – Plectranthus* community
ACB= *Artemisia – Cynodon – Berberis* community
VFV= *Viburnum – Fragaria – Viola* community
SAS= *Sibbaldia– Achillea – Senecio* community
VVP= *Viola – Viburnum – Pinus* community
ICB= *Indigofera – Cynodon – Berberis* community
VPP= *Viola – Picea – Pinus* community
AAP= *Abies – Adiantum – Picea* community
APA= *Adiantum – Picea – Abies* community
PPV= *Persicaria – Pinus – Viola* community

on the southern slopes at an elevation of 2700 m. It was characterized by the dominance of *Indigofera heterantha*, *C. dactylon* and *B. lycium*with IVs of 24.21, 37.34 and 28.44 respectively. The remaining 28 species were the associated members of this community. Heavy grazing and deforestation had caused woods becoming almost bushy in habit.

3.4.9. Viola – Picea – Pinus community (VPP)

This community harbours northern slopes at 2700 m and was comprising 37 species. It was dominated by *V. serpens*, *P. smithiana* and *P. wallichiana* with IVs of 177.10, 89.12 and 78.01 respectively. *P. amplexicaule* and *Fragaria indica* with IVs 59.02 and 37.81 respectively were the co-dominant elements of this community. The remaining 32 species were the associated components having less IVs in this community (Table 1). This community was also under severe biotic influence.

3.4.10. Abies – Adiantum – Picea community (AAP)

This community was characterized by the dominance of *Abies smithiana*, *Adiantum capillus-veneris* and *P. smithiana* respectively having IVs of 30.71, 29.82 and 28.91 in the south facing slopes of the hill top at an elevation of 3200 m. This community was associated by 46 species The community was less accessible to biotic influences, therefore, species diversity and coverage was high in this community (Table 1).

3.4.11. Adiantum – Picea – Abies community (APA)

This community was recognized on the north facing slopes at the top of the hill (altitude 3200 m). This community was dominated by *Adiantum capillus –veneris*, *P. smithiana* and *Abies pindrow* with IVs of 49.12, 42.39 and 41.46 respectively. This community was associated by about 40 species and it was mostly less accessible to grazing, over harvesting and deforestation, therefore, species diversity and coverage was comparatively high in this community (Table 1).

4. Discussion

4.1. Soil analysis

Habitat, including the physical and biological characteristic of a place is the address of an organism. The forest lands are characterized by a great diversity of soils due to wide differences in natural factors leading to the soil formation such as parent materials, climate and living matter. Human activities significantly modify the soil factor by inducing deforestation, erosion, overgrazing and compaction due to trampling by livestock. Similarly the soil composition is affected by many external factors like moisture, erosion , weather and plant litter. These factors also cause variation in soil nutrients, pH and electrical conductivity that is further modified by heterogeneity of the soil itself.

The soil of the investigated area was generally low in nutrients. This could be due to erosion which has removed the top fertile layer and organic matter which is raw material for nutrient release. Other workers also reported low nutrient status of the soil due to deforestation and erosion from various parts of Swat and our findings of study is consistant with theirs[10, 11]. At certain places the water holding capacity was relatively high, probably due to high organic matter contents. These sites also had tree and shrub layer. At the top a decreased water holding capacity resulted due to erosion and compaction of the soil as a result of trampling of grazing animals. Such nutrient deficient habitats with poor water holding and nutrient retention capacity are generally unfavorable for the growth of the seedlings of top story plants which are adapted to shady and organically rich soil conditions.

The air and soil temperature was slightly higher on south facing slopes compared to the north-east facing slopes [12-14]. The air and soil temperature was slightly higher in unprotected sites than protected sites. Moreover, in all the cases, there was a gradual decrease in temperature with rising altitude and at the top, both aspects had the same air and soil temperature. Some other workers also reported that south facing slopes of Docut Hills had higher temperature and lower humidity than north facing slopes and this agrees with the present findings[11]. Likewise two other ecologists have also observed that the north and south facing slopes of Karamar Hills had different micro climatic condition and hence vegetation[2,15]. The north and south facing slopes of Girbanr Hills also exhibit differences due to slope exposure and the present findings agree with them[16].

4.2. Floristic composition

The floristic list of Malam Jabba consists of 200 species belonging to 75 families, 65 dicots, 4 monocots, 2 gymnosperms and 2 pteridophytes while bryophytes and fungi are represented by one family each. Asteraceae was the dominating family in the study area. Previous studies also noticed that this family was well represented in Malakand Division. Lamiaceae, Poaceae and Papilionaceae were the next important families in the study area. Many other studies also reported these families to be well represented in other parts of Pakistan[4,5]. These are also the major families in the flora of Pakistan[3,5].

The present study observed that many species were found in the forest habitat and rangeland of the study area, having distribution, restricted life cycle with xeromorphic characters. This was reflected by small leaf size, stunted growth, sparse distribution, isolated individuals and dwarf height, *i.e.* all characteristics of xerophytic flora. Many species of Lamiaceae, Apiaceae and Asteraceae were aromatic.

A rich flora would definitely mean high species diversity and species richness in the study area. However, floristic composition is a qualitative character, and it alone cannot be a good indicator of forest productivity and health. This feature must be supplemented with some quantitative measurements to assess properly the health of forest ecosystem. Yet the floristic composition is a good source of plant life, gene pool and diversity of plants of any area and the present list serves this purpose. More over, the floristic list is helpful in short listing the species found in the area. It will help the forest and wildlife managers in their efforts for improving the wealth of an area.

4.3. Biological spectra

Physiognomic features such as life form and leaf size spectra are indicators of biotic interaction, climate and habitat deterioration. They have been widely used in understanding the flora and community structure in relation to prevailing environmental conditions. The overall vegetation of the study area is dominated by therophytes followed by hemicryptophytes and geophytes. The predominance of therophytes indicates a disturbed environmental condition where phanerophytes cannot establish themselves. Deforestation and overgrazing reduces the macro element of the vegetation. The same is true in this study as macro elements such as trees have been removed for earning livelihood, terrace cultivation and as a fuel wood source. This facilitates the dominance of other

life form classes. Other findings support our results as he also observed that extensive biotic influences increased short lived annuals[2,17]. The major climate is potentially phanerophytic which should have had coniferous forests in the study area. However, deforestation and overgrazing have reduced the tree vegetation to scrub and open grassland.

Leaf size spectra indicated that micro-nanophyllous species were dominating the area. In the study area, it was observed that plants suffer from adverse conditions such as poor soil development, short growing season and strong winds. Therefore, plants adapt themselves to the prevailing conditions to reduce their requirements by reducing their size, height, foliage and duration of growth. Therophytic and hemicrytophytic life form coupled with small leaf size is a good strategy of plants to cope with adverse environmental and deteriorated habitat conditions. Overgrazing and deforestation in such a climate further intensifies the adverse effects of environment.

4.4. Plant community structure

It was noticed during the present study that topographic, edaphic and biotic factors determine the shape, distribution and community set up within the major climatic zone. The vegetation under discussion is a moist temperate type where the original set up of the vegetation has been changed and all the reported eleven types of plant communities appear to present different degradational stages of the forest. The degradation results in the creation of shrub, grasslands or open patches consisting of crooked deformed trees in the area. It was also observed that the majority species are sporadic and shift to *Plectranthus – Themeda – Cynodon*, *Cynodon – Oxalis – Plectranthus* communities and other shrubby and herbaceous communities, where woody (trees) species exist either as co-dominant or insignificant members. It appears as if vegetation might ultimately change to an open degraded scrub, where non-palatable and less preferred generas like *Berberis*, *Indigofera*, *Senecio* and *Euphorbia* and other allied components may dominate. Our findings are in line with other studies which reported that in *Themeda – Medicago – Spergularia* communities around Muzafarabad, Azad Jammu and Kashmir, *Olea* remains as a co-dominant member, while in *Stellaria – Ranunculus – Gallium* communities, *Olea* occurs insignificantly[3,18]. The deforestation and degradation has changed the vegetation to an open scrub in which heliophytes might invade and dominate. The present study indicated that the vegetation originally was probably of pure coniferous stand. This is evident from the presence of *P. wallichiana*, *Abies pindrow*, *P. smithiana*, *Taxus wallichiana* and other associated under storey plants including our target species. This might have first changed to a scrub consisting of *B. lycium*, *Indigofera heterantha*, *V. nervosum*, *S. cuneata* and shrubby forms of tree layers along with other associated species. Further biotic pressure decreased the preferred and economically important plant species and increased *Indigofera*, *Berberis*, *Artemisia*, and *Senecio* and other non preffered elements as observed there. This ultimately was replaced with low productive grassland type of communities. *Abies – Adiantum – Picea* and *Adiantum – Picea – Abies* are the only communities, confined to higher elevation, and therefore, seems to be less affected by biotic influences.

Conflict of interest statement

We declare that we have no conflict of interest.

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