Article

Floristic composition, community syntaxonomy and ordination of Guzara (unprotected) forests of Hilkot range, District Mansehra, KP, Pakistan

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Abstract

The present study was planned to assess the quantitative and qualitative characteristics of floristic diversity at species level along environmental gradients by using a TWINSPAN for recognizing major plant communities of Sathan Gali [Guzara forest (unprotected)], Mansehra, KP, Pakistan. On the basis of vegetation physiognomy, the study area was divided into 22 stands. Total 105 plant species of 55 families were recorded. The dominant family was found to be Poaceae by 11 plant species followed by Asteraceae and Rosaceae each represented by 10 species, and Pteridaceae by 5 plant species. Three plant communities were recognized through TWINSPAN classification viz *Pinus-Sarcococca-Pteris* community (PSP), *Pinus-Cedrus-Indigofera* community (PCI) and *Alianthus-Cynodon-Themeda* community (ACT).The maximum gradient length was 2.49 contributed by axis I. The gradient length of axis II was 2.00. The explained variation for axis I and II were 17.59 and 26.27 respectively. Among environmental variables the maximum strength was recorded for altitude, nitrogen, wind pressure, electrical conductivity and phosphorus. The minimum strength was recorded for aspects. Maximum species diversity was measured of Pinus-Sarcococca-Pteris Community (PSP) (0.106) while species richness was found in *Alianthus-Cynodon-Themeda* Community (ACT) (2.45) whereas maximum species maturity was found in *Pinus- Cedrus- Indigofera* Community (PCI) (115.65). The current investigation will enhance the understanding of the phytosocialogists to categorize, differentiate and discuss dynamics of the plant communities. This study will serve as a base line for further researches in the field of community ecology.

Keywords phytosociology; biological spectrum; TWINSPAN; Sathan Gali; Pakistan.

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1 Introduction

Phytosociology is the study of characteristics, classifications, relationships, and distribution of plant communities (Mueller-Dombois and Ellenberg, 1974). In the 20th century great efforts were made in the field of ecology and phytosociology. The leading species represent the major trends in the local vegetation allows the ecologists to recognize and differentiate the plant communities (Leveque, 2001). In the last few decades scope of phytosociology became wider and investigates number of quantitative, qualitative and synthetic characteristics of plant communities e.g. density, dominance, abundance, floristic composition, vegetation structure, physiognomy, development and exchange multilateral relations of plants to one another and to the environmental variables and the classification of communities (Rieley and Page, 1990).

The existence of distinct forest types is exploratory of diversity in climatic and edaphic factors (Kent, 2012). Any type of changes in habitats are first observed in the vegetation. Vegetation is the result of the habitat, environmental conditions and existing biodiversity. Such study provides information about recognition and definition of different vegetation types, plant communities, relationship between plant species distribution and environmental variables (Zhang, 2017b). Such studies are also plays an important role in prediction of possible future changes (Kent and Coker, 1994).

Ecological diversity is regarded as a measure of the quality of an ecosystem (McGardy-Steed and Morin, 2000). In modern era, changes in floristic diversity along the environmental gradients are an important issue of ecological exploration (Currie and Francis, 2004). Monitoring of vegetation is an easy way for understanding the climatic conditions of an area (Niemi and McDonald, 2004). With climate change, phytosociological studies will become more important because in most cases, only vegetation data is available to use for making comparisons (Mueller-Dombois and Ellenberg, 1974). Plant communities as concrete definable units of vegetation that can be recognized and are apparent to the eye. Plant communities are often named after species that contribute to their unique structure or composition. The altitude, latitude, slope angle, aspect and humidity play an important role in formation and composition of plant community (Currie and Francis, 2004; Shaheen et al., 2012).

Species diversity is measured mathematically by indices and provides information about species richness, consistency and community composition as well as rarity or commonness of a species (Whittaker, 1977; Zhang, 2017a). Maturity index indicates about the ongoing climax trend as well as successional variations in a given community under the impact of ecological conditions and through this index we can find out the best suitable and favorable altitudinal zones for the plants (Rodolfo and Sermolli, 1948). Modern software packages have made the phytosociological studies more meaningful and predictable. A growing number of studies have used software packages. Peer et al. (2007) applied TWINSPAN and recognized 11 plant communities in Hindu Kush Mountains. Farooq et al. (2019) reported 12 plant tree communities from upper Tanawal Mansehra, KP. Hussain et al. (2008) conducted study on species composition and community structure of 23 forest stands in Kumaon Himalaya. Out of which, they reported 19 tree communities and 17 ground vegetation communities. The distribution of tree species on DCA axis 1 showed influence of altitudinal gradient while the second axis of DCA indicated canopy cover and shrub diversity. Haq et al. (2015) also evaluated similar approaches for the recognition plant communities. The present study was specifically designed with the objectives to investigate and correlate the vegetation of Guzara forests of Sathan Gali (Study area) with environmental gradients and to classify the vegetation structure into plant communities with its ecological characteristics. Guzara forests are unprotected forests where anthropogenic disturbances upset the vegetation structure. There is an utmost need to study the vegetation in the context of phytosociological attributes of such areas. Therefore, the present study will be helpful for the conservation and sustainable utilization of plant resources of the area and also for further ecological investigations.

2 Study Area and Methodology

2.1 Study site

The study area, Hilkot range of Sathan Gali is situated between 34.36132 to 34.36650 North and 73.11067 to 73.12488 East longitude in district Mansehra. The district consists of three sub divisions that is Mansehra, Oghi, and Balakot (Fiaz, 2012).The area receives heavy rain fall in winter and Monsoon. The temperature of the area remains pleasant throughout the year except May and June. This heavy snow causes physical damage to the vegetation. In May and June the temperature is high as compared to rest of the months (Khan *et al*., 2016). The rocks are gneiss, schists, granitoid gneisses, mica schist and shales. Soil possesses higher moisture retaining capacity under the vegetation cover and acidic in nature. Terraces on hills slopes are constructed for cropping but they are not effective and durable. The soil from such slopes get washed away within two to three years and barren bed rocks left behind (Saddozai, 1996).

2.2 Data collection

An extensive field surveys were carried out to study the phytosociological attributes of Sathan Gali (Guzara forest), Mansehra, Pakistan at regular intervals of different seasons, during 2013-2015. The whole area was divided into 21 stands on the basis of physiognomy of vegetation.

Quadrate method was used for sampling the vegetation. The size of quadrate was 10 × 2 m^2 for trees 5× 2 m^2 for shrubs and 1× 1m^2 for herbs (Malik, 1986). The number of quadrates for trees, shrubs and herbs were 5, 10 and 20 respectively. The life form classes and leaf spectra of all plant species were determined and classified following Raunkiaer (1934).The Collected plant specimens of each species were dried, poisoned and mounted on standard herbarium sheets. The collected specimens were identified with the help of Flora of Pakistan (Nasir and Ali, 1971-1994; Ali and Qaisar, 1995-2004) and voucher specimens were deposited in the Herbarium, Hazara University Mansehra, KP, Pakistan (HUP). Soil samples, down to a depth of 30cm, were collected from each stand.

2.3 Analysis of data

The recorded data was analyzed through CANOCCO software package (Haq et al., 2015). These soil samples were analyzed following Allen et al. (1986) methodology for percentage of sand, silt and clay, total organic matter (OM. %), pH and electrical conductivity at Agriculture Research Station Baffa.

3 Results and Discussion

3.1 Floristic diversity of guzara forest

A total of 105 plant species belonging to 55 families were enlisted from the Guzara forest of Sathan Galli. These plant species were recorded from 22 sampling stands. Angiosperms were represented by 96 species (92.3%), Gymnosperms by 3 species (2.88%) and Pteridophytes by 5 species (4.8%). The dominant family was found to be Poaceae by 11 plant species followed by Asteraceae and Rosaceae each contributed 10 species, and Pteridaceae by 5 species. Habit wise categorization shows 72 herbs, 15 shrubs and 17 trees species.

3.2 TWINSPAN classification of vegetation of guzara forest

The data of 105 plant species of 22 stands were analyzed by TWINSPAN classification (Fig. 1) Three plant communities were recognized viz *Pinus-Sarcococca-Pteris* community(PSP), *Pinus-Cedrus-Indigofera* community (PCI) and *Alianthus-Cynodon-Themeda* community (ACT).

3.2.1 *Pinus-Sarcococca-Pteris* Community (PSP)

Pinus wallichiana-Sarcococca saligna–Pteris vitata Community was recorded at an altitude of 6000–6200 feet in stands 9, 16, 17, 18 and 19. The co-ordinates range was 34 .6070 to 34. 6085 N and 73.1976 to 73.1989E. The steepness of slope was 40-75^0 on South and East aspect. A total of 28 plant species were recorded in this community. The dominant plant of this community was *Pinus wallichiana* with IVI 134.42. *Sarcococca saligna* and *Pteris vitata* were co-dominant with IVI 54.57 and 14.16 respectively.

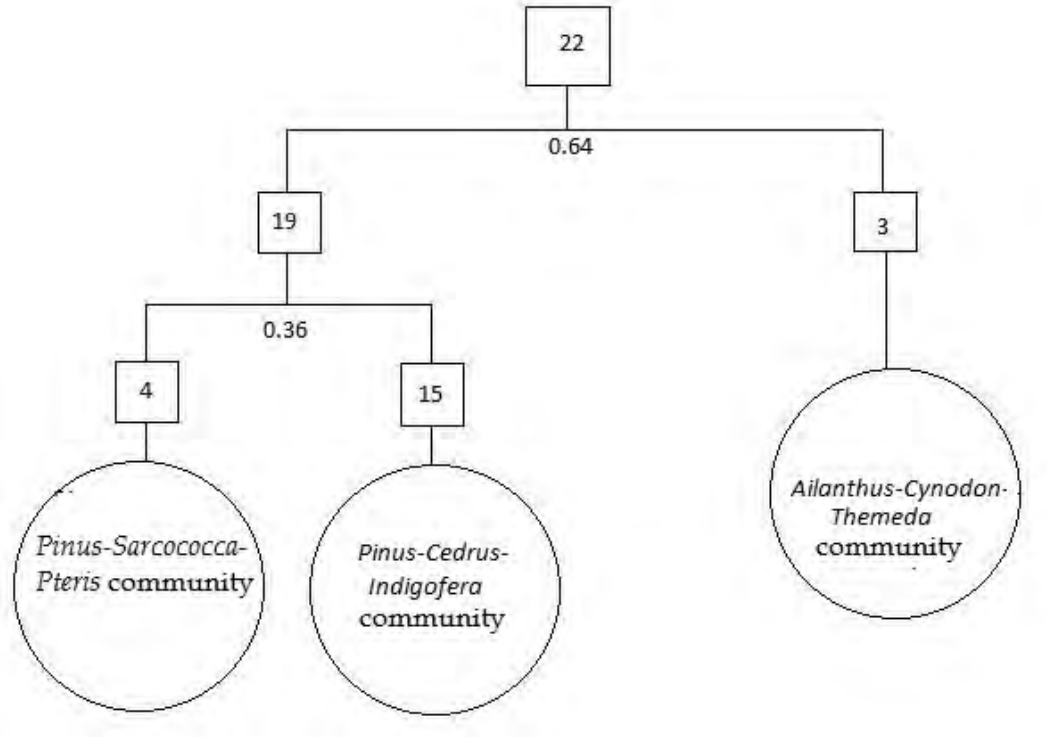

Fig. 1 TWINSPAN classification of vegetation of Guzara forest.

Therophytes were dominant by contributing 10 species followed by Geophytes and Hemicryptophytes 6 species by each (Fig. 2). A leaf size spectrum was dominated by Microphyll represented by 11 plant species followed by Nanophyll by 10 plant species (Fig. 3). The values of species diversity, species richness and species maturity were 0.106, 52.72, and 115.65 respectively (Table 1). Soil of this community was silty loam with highly acidic pH, nitrogen 0.028-0.061%, potassium 112 -127 ppm, phosphorus 3–4.5 ppm and electrical conductivity 1.1 - 2.1 dc/m. The soil was also found rich in organic matter.

3.2.2 *Pinus- Cedrus-Indigofera* Community (PCI)

Pinus wallichiana-Cedrus deodara-Indigofera heterantha community was reported at an elevation of 6300-6800 feet. The co-ordinates range was 34.6089 to 34.6758N and 73.1841 to 73.20 250E. This community was recorded in stands 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, and 34 from East, South and West aspects with 30–70^{o} slope of steepness. *Pinus wallichiana* was found dominant with IVI 418.19. *Cedrus deodara* and *Indigofera* were co-dominant species with IVI of 140.25 and 106.24 respectively. A total of 76 plant species were recorded in this community.

Therophytes were dominant life form of the vegetation with contribution of 17 plant species followed by Geophytes with addition of 16 species to the total and nanophanerophytes by 14 plant species (Fig. 2). Among leaf size Mesophyll were dominant by contributing 25 species and Microphyll by 24 plant species (Fig. 3). The values of species diversity, species richness and species maturity were 0.066, 1.30 and 115.65 respectively (Table 1). Sandy clay loam and loam soil of this community had high acidic pH, less organic matter, potassium, phosphorus and nitrogen were between in range of 88-131 ppm, 3-6 ppm and 0.018- 0.68% respectively. The electrical conductivity was 1.1-2.4 dc/m.

3.2.3 *Alianthus-Cynodon-Themeda* Community (ACT)

Alianthus altisema-Cynodon dactylon-Themeda anathera Community was recorded at an elevation of 5500–6400 feet in stands 14, 15, and 35. The co-ordinates range was 34.6012 to 34.66669 N and 73.17252 to 73.20534E. The steepness of slope was 45-70^{o} on South and West aspect. A total of 58 plant species were recorded in this community. The dominant plant of this community was *Alianthus altisema* with IVI 134.42. *Cynodon dactylon* and *Themeda anathera* were co-dominant with IVI 15.57 and 11.06 respectively.

Megaphanerophytes were dominant by contributing 17 species followed by Therophytes by 14 species and Hemicryptophytes by 12 species (Fig. 2). Leaf size spectra were found dominant by Mesophyll 20 plant species followed by Microphyll 17 plant species (Fig. 3). The values of species diversity, species richness and species maturity were 0.086, 2.45 and 46.29 respectively (Table 1). Soil of this community was silty loam and sandy clay loam with highly acidic pH, nitrogen 0.033–0.6%, potassium 110-128 ppm, phosphorus 4.5-6 ppm and electrical conductivity 0.5-2.6 dc/m. Organic matter was high in this community.

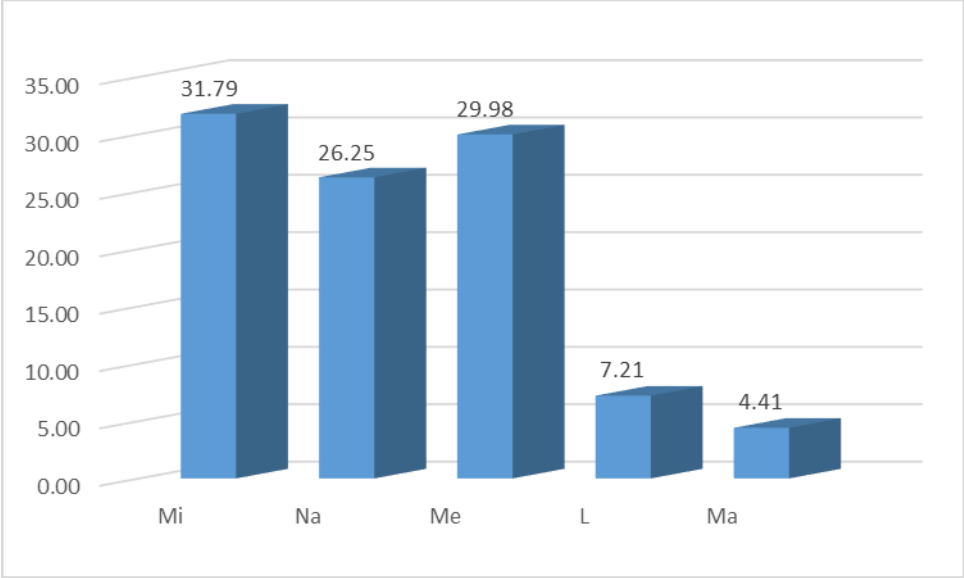

Fig. 2 Leaf spectra of vegetation of Guzara forest.

Table 1 Plant species diversity and its components of vegetation of Guzara forest.

S.No	Name of community	Species diversity	Species richness	Species maturity
1	*Pinus-Sarcococca-Pteris* Community (PSP)	0.106	1.22	52.72
2	*Pinus- Cedrus- Indigofera* Community (PCI)	0.066	1.30	115.65
3	*Alianthus-Cynodon-Themeda* Community (ACT)	0.085	2.45	46.29

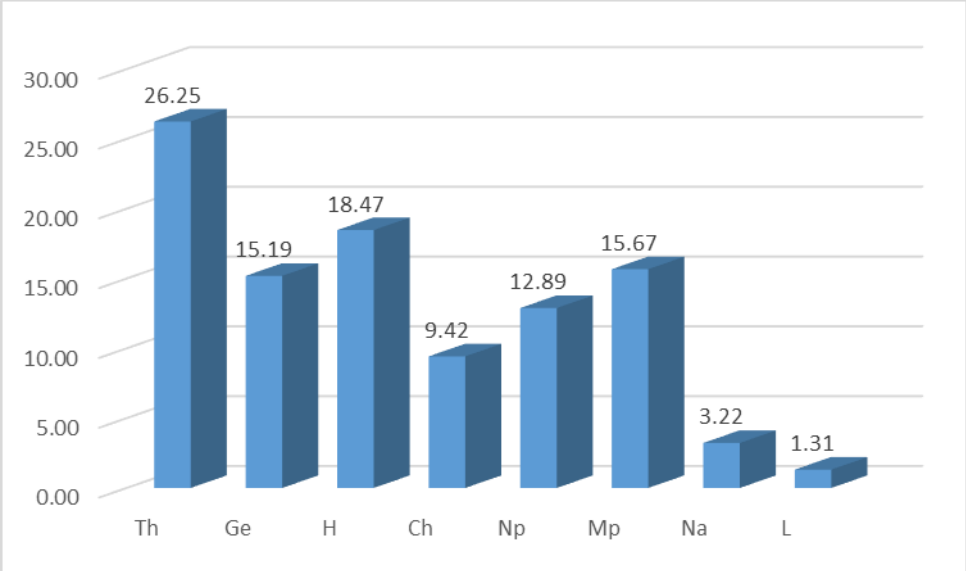

Fig. 3 Life form of plant species of Guzara Forest.

3.3 DCA ordination

In unimodal DCA ordination the response data was compositional with 2.5 SD unit large gradient length. The total variation in the specie data was 2.88. The maximum Eigenvalue for axis I was 0.50 and 0.24 for axis II. The maximum gradient length was 2.49 contributed by axis I. The gradient length of axis II was 2.00 (Fig. 4-5). The explained variation for axis I and II were 17.59 and 26.27 respectively. The DCA ordination of species showed that different specie clustered in ordination space on both positive and negative sides from average position. The species which were positively correlated with each other and with axis I were *Pteridium* sp., *Oxalis corniculata*, *Viburnum grandiflorum* and *Pteris cratica.* These species were negatively correlated with axis II. The species which were positively correlated with axis I and II were clustered at the top of ordination space including *Abies pindrow*, *Duchesnea indica*, *Poenia emodie*, *Sorbaria tomentosa*, *Viburnum cotonifolium*, *Fragaria nubicola* and *Rosa moschata.*

The species which were positive correlated with axis II and negatively correlated with axis I were *Populus alba*, *Dryopteris stewartii*, *Artimisea absenthium*, *Dodonaea viscosa*, *Melia azedarach*, *Morus alba*, *Morus nigra*, *Prunella vulgaris* and *Diospyros lotus*. The species which were negatively correlated with both axis I and II were *Rumex hastatus*, *Cichorum intybus* and *Rumex dentatus* while *Clinopodium vulgare lie* near average position. The DCA ordination of stands also showed that the stands of different communities lie close to each in ordination space as sorted out by TWINSPAN classification. *Pinus-Cedrus-Indigofera* Community (PCI) and *Pinus- Sarcococca-Pteris* Community (PSP) lie near to axis I while community no 3 was at the top of the ordination space. *Alianthus-Cynodon-Themeda* Community (ACT) was different in species composition and habitat type from *Pinus-Cedrus-Indigofera* Community (PCI) and *Alianthus-Cynodon-Themeda* Community (ACT).

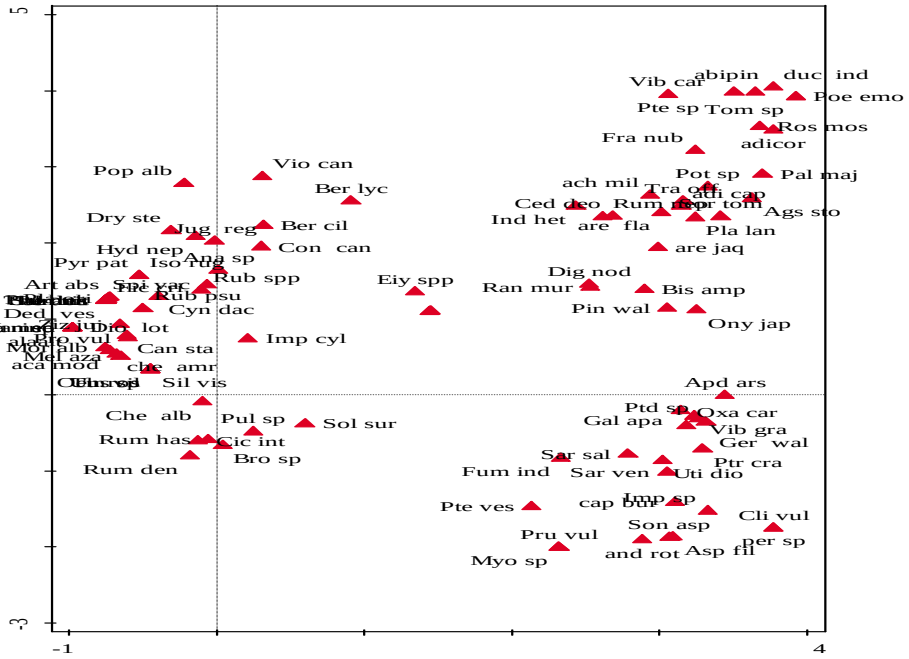

Fig. 4 DCA ordination of plant species of Guzara Forest.

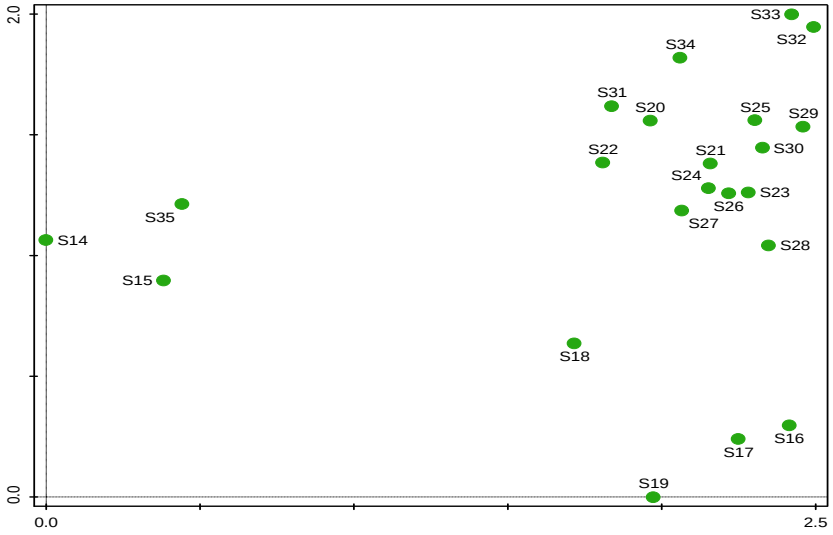

Fig. 5 DCA ordination of stands of Guzara Forest.

3.4 CCA ordination

The outcome of CCA ordination showed that the total variation was 2.88, explanatory variable accounts for 76.2 % while the adjusted explained variation was 16.5%. This means that the species behave differently with environmental variables. Some variables have great effect on species distribution as compared with other variables. The Eigen value for axis I was 0.48 and 0.28 for axis II. The psedocanonical correlation for axis I and II was 0.98 and 0.94 respectively. This means that the species were in linear combination with environmental variables. The permutation test result showed that pseudo F=1.3 for all axis. While the P =0.074. The F value is less significant while the p value is more significant. Among environmental variables the

maximum strength was recorded for altitude, nitrogen, wind pressure, electrical conductivity and phosphorus. The minimum strength was recorded for aspects (Fig. 6-7).

The species which were positively correlated with each other and environmental variables like wind pressure, nitrogen and organic matter were *Isodon rugosus, Pyrus pashia, Platanus orientalis, Dodonaea viscosa, Stellaria media, Malva neglecta, Diospyrous lotus, Swertia ciliate, Desmodium elegans* and *Ficus carica.* The species which were positively correlated with altitude, aspects, texture and latitude were *Agrostis stolonifera, Abies Pindrow, Viburnum cotinifolium, Achellia mellefolium* and *Pteris* sp. The species which were positively correlated with potassium and moisture were *cichorum intuybus, Melia azadarach, Impations sp,* and *Hedra nepalensis. Some of the species like Calamentha umbrosa, Quercus dilatataand, Oenothera rosea* were at the top of ordination space and were most sensitive with environmental variables on axis I as compared to other species. While a single species *Indigofera heterantha* influenced by environmental variable and lie closer to average position.

The CCA ordination of stands showed that maximum of the stands lie on the negative side of the axis, I and II from average position. Few stands were positively correlated with axis II and negatively correlated with axis I. The stands were strongly positively correlated with axis I and slightly negatively correlated with axis II. One stand that contributed 35 species was strongly correlated with axis II as well as with axis I and lie at the top of ordination space. This indicated that the species of this stand were more diverse as compared to other stands.

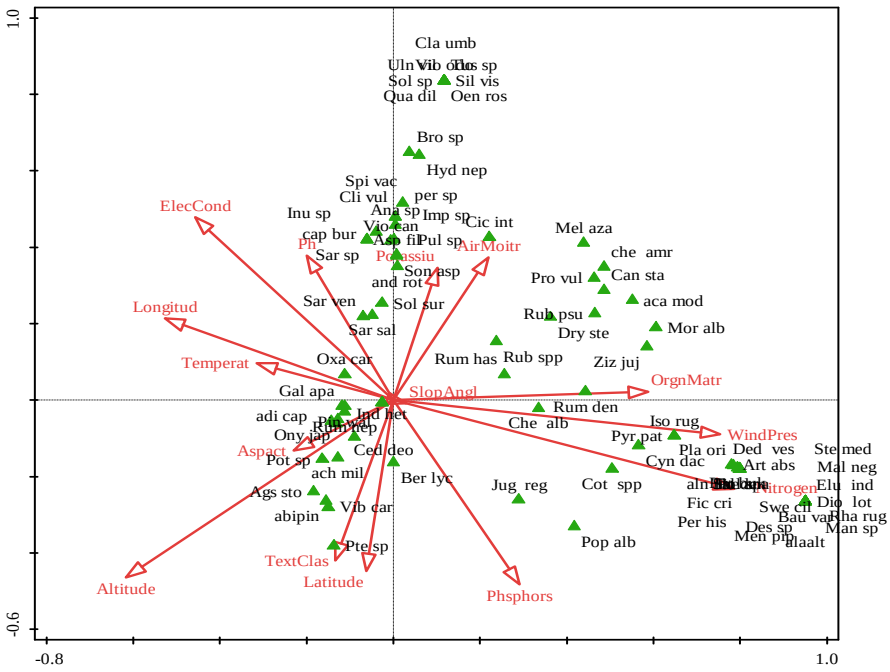

Fig. 6 CCA ordination of plant species of Guzara Forest.

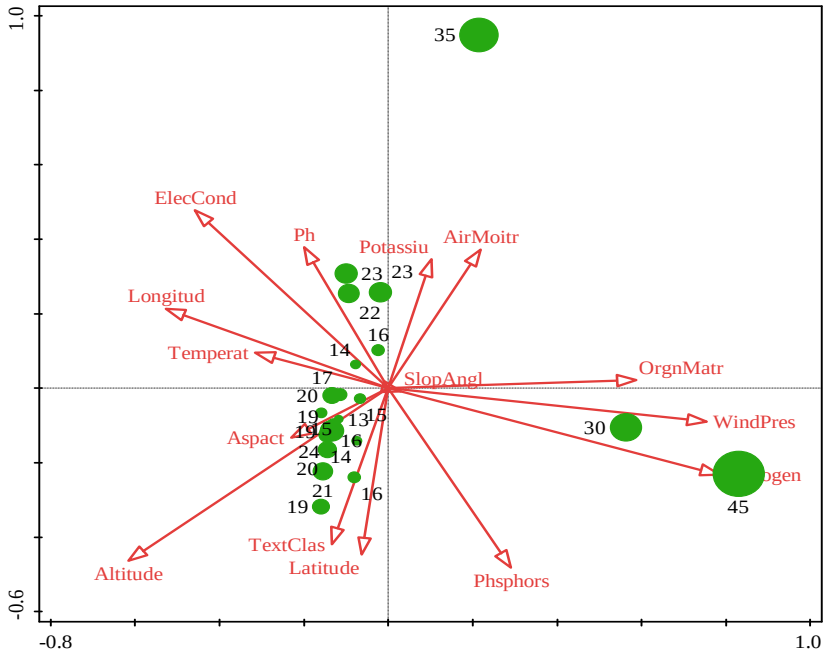

Fig. 7 CCA ordination of stands of Guzara Forest.

Floristic diversity of a region is related to environmental gradients such as elevation, temperature, rain etc. of an area. Pakistan harbors rich floristic diversity due to an important geographical position. The study area being the part of western Himalayas shows rich floristic diversity. A total of 105 plants species belonging to 55 families were documented from Guzara forest (Unprotected) of Sathan Gali in spite of anthropogenic disturbances. Our findings are in close agreement with many researchers of allied and neighboring regions (Ijaz, 2014; Ijaz et al., 2015; Khattak et al., 2015; S.M. Khan et al., 2015; K.U. Khan et al., 2015; Shah et al., 2015; Ahmad et al., 2016; Rahman et al., 2016a, b).

It was found that environmental gradients like altitude, aspect and topographic features play significant roles in floristic composition and ecological dynamics. According to Berg et al. (2000) the precipitation and elevation strongly influence the floristic diversity in different forests. The plant biodiversity of an area is mostly depends upon variation in altitude (Shaheen *et al.*, 2016). Adam and Mamat (2005) found that the topographic changes influence forest composition along topographic incline. Madsen and Ilgaard (2008) documented that floristic diversity is altered particularly with the passage of time.

Phytosociology is the study of plant communities. While a community is assemblage of plant population formed in one habitat type in a specific area, showing mutual competition and dependence. The existence and establishment of plant communities indicates the plant type and habitat condition under which they develop (Malik, 1986). Elevations, aspect, degree of slope and precipitations are most important variables affecting the distribution of plants species in mountainous areas (Titshall et al., 2000).

The data collected from 22 stands of 770 quadrats resulted in a total of 3 different plant communities recognized by TWINSPAN viz (1) *Pinus-Sarcococca-Pteris* Community (PSP); (2) *Pinus-Cedrus-Indigofera* Community (PCI); (3) *Cynodon-Themeda* Community (ACT). The results of current study were analogous to phytosociological survey of Nandiar Khuwar catchment district Battagram, Khyber Pakhtunkhwa, Pakistan (Haq et al., 2015).

In unimodal DCA ordination the response data was compositional with 2.5 SD unit large gradient length. The total variation in the species data was 2.88. The maximum Eigenvalue for axis I was 0.50 and 0.24 for axis

II. The maximum gradient length was 2.49 contributed by axis I. The gradient length of axis II was 2.00. The explained variation for axis I and II were 17.59 and 26.27 respectively. The DCA ordination of species showed that different species clustered in ordination space on both positive and negative sides from average position. The species which were positively correlated with each other and with axis I were *Pteridium* sp., *Oxalis corniculata, Viburnum grandiflorum* and *Pteris cratica.* The species which were positively correlated with axis I and II were clustered at the top of ordination space including *Abies pindrow, Duchesnea indica, Poenia emodi, Sorbaria tomentosa, Viburnum cotonifolium, Fragaria nubicola and Rosa moschata*.

The outcome of CCA ordination showed that the total variation was 2.88, explanatory variable accounts for 76.2 % while the adjusted explained variation was 16.5%. This means that the species behave differently with environmental variables. Some variables have great effect on species distribution as compared with other variables. The Eigen value for axis I was 0.48 and 0.28 for axis II. The psedocanonical correlation for axis I and II was 0.98 and 0.94 respectively. This means that the species were in linear correlation with environmental variables. The permutation test result showed that pseudo F value is 1.3 for all axes, whereas, the Peasrson index (P) is 0.074. The F value is less significant while the P value is more significant. Among environmental variables the maximum strength was recorded for altitude, nitrogen, wind pressure, electrical conductivity and phosphorus. The minimum strength was recorded for aspects.

The species positively correlated with environmental variables like wind pressure, nitrogen and organic matter were *Isodon rugosus, Pyrus pashia, Platanus orientalis, Dodonaea viscosa, Stellaria media, Malva neglecta, Diospyrous lotus, Swertia ciliata, Desmodium elegans* and *Ficus carica*. The species which were positively correlated with altitude, aspects, texture and latitude were *Agrostis stolonifera, Abies Pindrow, Viburnum cotinifolium Achellia mellefolium* and *Pteris* sp. The species which were positively correlated with potassium and moisture were *Cichorium intuybus, Melia azadarach, Impations* sp, *and Hedra nepalensis.* Some of the species like *Calamentha umbrosa, Quercus dilatata* and *Oenothera rosea* were at the top of ordination space and were most sensitive with environmental variables on axis I as compared to other species. While a single species *Indigofera hetrantha* influenced by environmental variable and lies closer to average position.

The CCA ordination of stands showed that maximum of the stands lie on the negative side of the both axis, axis I and II from average position. Few stands were positively correlated with axis II and negatively correlated with axisI. One stand that contributed 35 species was strongly correlated with axis II as well as with axis I and lie at the top of ordination space. This indicated that the species of this stand were more diverse as compared to other stands. The species which were positively correlated with axis II and negatively correlated with axis I were *Populus alba, Dryopteris stewartii, Artimisea absenthium, Dodonaea viscosa, Melia azedarach, Morus alba, Morus nigra, Prunella vulgaris* and *Diospyros lotus.* The species which were negatively correlated with both axis I and II were *Rumex hastatus*, *Cichorum intybus* and *Rumex dentatus*, while Clinopodium vulgare lie near average position.

The DCA ordination of stands also showed that the stands of different communities lie close to each other in ordination space as sorted out by TWINSPAN classification. *Pinus-Cedrus-Indigofera* Community (PCI) and Pinus- Sarcococca-Pteris Community (PSP) lie near to axis I while community *Alianthus-Cynodon-Themeda* (ACT) was at the top of the ordination space. *Alianthus-Cynodon-Themeda* Community (ACT) was different in species composition and habitat type from Pinus-Cedrus-Indigofera Community (PCI) and *Alianthus-Cynodon-Themeda* Community (ACT).

These result showed that there is strong association of species and habitat types or environmental variables. CCA technique is used to find out the relationship between environmental variable and vegetation. This CCA analysis has also been used to determine the vegetation-environmental relationship (Haq, 2015; Mehmood et

al., 2015). It is therefore, important to correlate the vegetation structure of the area with environmental variables for a proper understanding of the of plant species distribution mechanism in an area (Eriksson and Bergstrom, 2005).

The life form of plants is an adaptive response to environment and provides an ecological classification that may be indicative of habitat conditions (Archibold, 1995). Occurrence of similar biological spectra in different regions indicates similar climatic conditions. Biological spectra are helpful in comparing geographically widely separated plant communities and are also regarded as indicator of prevailing environment. The biological spectrum was dominant by Therophytes 51 spp. (30.35%) followed by hemicryptophytes 34 spp. (20.23%). The dominance of Therophytes in the study area indicated that the investigated area is under heavy biotic pressure due to deforestation and over grazing and soil erosion. The present findings are in agreement with Shaheen et al. (2016), who also reported Therophytes as the leading life form in Havelian, Abbottabad, Pakistan. Malik et al. (1994) and Malik et al. (2001) observed that in the moist temperate part of Dhirkot and Neelum valleys of Kashmir region, hemicryptophytes and Therophytes were the dominant lifeform classes. Our findings are not in agreement with Malik (2005) who reported hemicryptophytes and Therophytes were dominating in Ganda Chotti and Bedori hills at an elevation of 1700–3700 m. Our study area is unprotected where anthropogenic effects upset the vegetation structure. Malik (2004) reported that qualitatively nanophanerophytes and hemicryptophytes were dominant in Kotli hills. Leaf spectra are characteristic of the existing environmental and habitat conditions of any area (Hussain et al., 2015). The leaf size spectrum was dominated by Microphyll contributing 68 (40.47%) species, followed by Mesophyll containing 45 (26.78%) species. Malik et al. (2007) found microphyllous and nanophyllous as the dominant leaf size from Kotli Azad Kashmir and Waziristan.

4 Conclusions

A total of 105 plant species belonging to 55 families were documented from the Guzara forest of Sathan Galli. The dominant family was found to be Poaceae followed by Asteraceae and Rosaceae and Pteridaceae. Three plant communities were recognized viz *Pinus-Sarcococca-Pteris* community (PSP), *Pinus-Cedrus-Indigofera* community (PCI) and *Alianthus-Cynodon-Themeda* community (ACT) By TWINSPAN classification. Mesophyll and Microphyll were found dominant Leaf size spectra. Therophytes and Hemicryptophytes were leading life form class of the vegetation of study area. Among the environmental variables altitude played a significant role in the distribution of plant communities. The present study will be helpful for the conservation and sustainable utilization of plant resources of the area and also for further ecological investigations.

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