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Plant Life Classification in Summer of Tehsil Takht-e-Nasrati, District Karak, Khyber Pakhtun Khawa, Pakistan

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Authors' contributions

This work was carried out in collaboration between all authors. Author MK designed the study, performed the field work and statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Author FH managed the analyses of the study. All authors read and approved the final manuscript.

Research Article

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ABSTRACT

Aims: The study was designed to explore the floristic composition and vegetation classification.
Place and Duration of Study: A survey of natural vegetation of Tehsil Takht-e-Nasrati, District Karak was undertaken in summer 2010-2011. The study was conducted within four distinct stands further divided into 22 sites for clear communities' segregation.
Methodology: Hierarchical Cluster Analysis (HCA), and Detrended Correspondence Analysis (DCA) were used for the plant community analysis. Plant species of each community type are presented together with the information on dominance and sub dominance species.
Results: Five plant association i.e. Cenchrus-Saccharum-Prosopis association, Cenchrus-Eragrostis-Calligonum association, Zizyphus-Cenchrus-Eragrostis association, Rhazya-Fagonia-Cymbopogon association and Aerua-Boerhavia-Zizyphus association were recognized and 46 species were recorded.
Conclusion: Classification and ordination techniques provided very similar results based on the floristic composition and communities similarity. The results produced the source for the mapping division of plant life communities.

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Keywords: HCA; DCA; community association; summer season; Tehsil Takht-e Nasrati.

1. INTRODUCTION

Ordination techniques are commonly used in phytosociology. This may be done either by arranging the points along the axis or by forming the scatter diagram with two or more axis. Detrended Correspondence Analysis (DCA), an indirect gradient analysis technique in which the distribution of species is not controlled by environmental variables rather, it focuses to analyze the pattern of species distribution. Environmental data for DCA is not required and species data is used to assume the gradients [20]. Ordination techniques are widely used by the ecologists to study the relationship between vegetation and environment. Author [16] conducted a study in Chott El Beida wetland, a RAMSAR site in Setif, Algeria to study distribution of plants community and environmental factors. The collection was done from sixty vegetation plots. TWINSPAN and Detrended Correspondence Analysis (DCA) were used as the analysis techniques. A similar study was conducted by [3] along motorway (M-2), Pakistan using multivariate techniques i.e., DECORANA. Results showed two major and sixteen sub-communities from 397 quadrats. The study was helpful for implementation and conservation planning and for the improvement of road sides. To study the relationship between vegetation and environment, a study was conducted by [9] in the Alxa Plateau of Inner Mongolia, China which resulted in the detection of six characteristics vegetation groups by using the Detrended correspondence analysis (DCA). Author [2] studied the herbaceous vegetation in Margalla Hills National Park, Islamabad, Pakistan. Four vegetation groups were recognized by TWINSPAN. Author [7] studied *Juniperus phoenicea* L. and associated vegetation at three mountains in Egypt, resulted in the recognition of four vegetation types along with juniper by TWINSPAN and DCA analysis techniques. [12] conducted a study to analyze the vegetation and environment data of Ayub National Park, Rawalpindi. PCOrd 5 and CANOCO 4.5 were used and data was recorded by quadrat method. 44 plants species from 30 quadrats were recorded. Many researchers [3,4,5,6,15,17,21,26,27] have studied different aspects of vegetation structure and classification and ordination distribution patterns in different parts of Pakistan. Classification and ordination is an invaluable method for vegetation survey and assessment involving investigation of characteristics of plant communities using simple and rapidly employing field techniques [8]. In the present study, an effort has been made to investigate and analyse correlation of communities with key environmental factors. The Tehsil Takht-e-Nasrati comprises one of the richest and most interested ecosystems on earth. The community structure and distribution patterns of research area have not been given due attention till the date by the plant ecologists, and hence poorly understood [14]. The particular objectives of present study include quantifying the vegetation in spring season of Tehsil Takht-e-Nasrati, District Karak using ordination techniques for upcoming conservation and providing base line data of ecological important area.

2. MATERIALS AND METHODS

2.1 Field Data Collection

Floristic data were collected from 22 randomly selected sites from 4 stand selected on the basis of altitude. Quadrat method was used for the collection of vegetation data. Each field site comprised of 10 Quadrats for each plant layer i.e. tree (10X10m), shrubs (5X5m) and herbs (1X1m). The latitude and longitudes were recorded for each site using a Global Positioning System (GPS). Sampling was completed in summer season. The summer

season starts in Jun – August. Collected samples were pressed, dried and transported to herbarium, Department of Botany, University of Peshawar, Khyber Pakhtunkhawa, Pakistan, where they were identified and classified following [21,22] and a fraction of angiosperms of Tehsil Banda Daud Shah by Khan [13].

2.2 Data Analysis

Vegetation attributes including frequency, density and cover were recorded along with environmental coordinates like latitude, longitude, altitude and slope using GPS. The importance value of each species was compiled adding RD, RF and RC following [11]. On the basis of the highest importance values of the first three dominant species from each layer, the communities were established and named. All the species data, as well as the field sites communities, were used for the analysis. The data was classified using standard methods Hierarchical Cluster Analysis (HCA) and Detrended Correspondence Analysis (DCA) [10] to summarize biological records and position of communities in groups during summer. The plant life associations were named after the highest value of three dominant species. DCA ordination offered two significant ordination axes on the basis of weight for communities. Detrended Correspondence Analysis (DCA) were performed to describe compositional gradients in the vegetation. All analysis was performed using the software PCORD ver. 4.16 [18].

2.3 Research Area

The Tehsil Takhti Nasratti is situated at 32.47º to 33.28º North and 70.30º to 71.30º East. The Tehsil is bounded by Tehsil Banda Dawood Shah on the North West, Tehsil Karak on the North East, District Mianwali and District Lakki Marwat on the South East, and Tribal area Adjoining District Bannu on the South West (Fig. 1). The total area of Tehsil is about 613.66 Sq. kilometer. Majority of the area consists of rigged dry hills and rough fields areas i.e. 323.97 Sq. kilometers and agriculture land is about 289.7 Sq. kilometer. The major income source of the people is Agriculture, which is rain depended. The area is situated at 340 m above the sea level. Environmental data showed that mean air temperature was high in month of June (39.5ºC) and low in month of September (21.95ºC), relative humidity was high (77.21%) in month of September and low (30.73 %) in May, rainfall (121.6 mm) was high in July and low (31.6 mm) in May, soil temperature (26.77ºC) was high in month of July, wind speed was high in month of June (5.5 Km/h) and low (3.7 Km/h) in September, which indicated dry condition during summer. Summer season started from May to September in the area and 11 plant communities were recognized in plains. The investigated area shows altitudinal variation i.e. from 340m - 500m. This also caused deviation in plant life structure (Table 1).

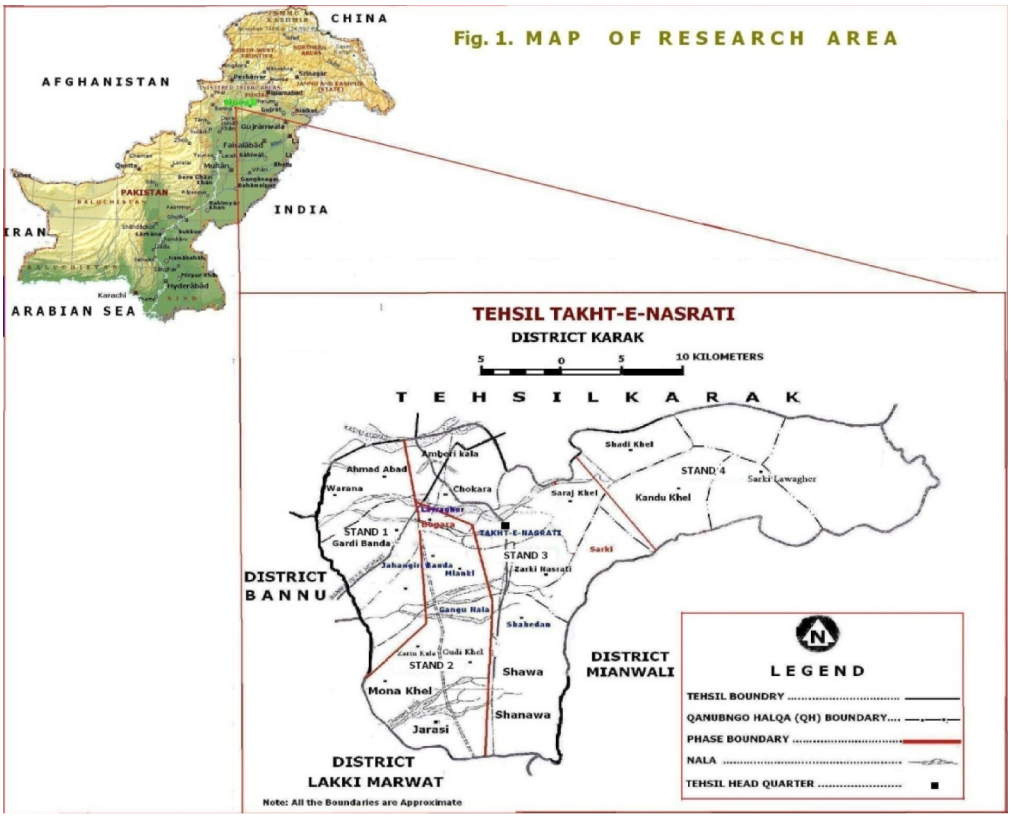

Fig. 1. Map of Tehsil Takht-e- Nasrati, District Karak showing research spots

Table 1. Meteorological data of Tehsil Takht -e –Nasrati, District Karak for the year 2001-2010

Months	Temperature (Cº)		humidity (%)		Rainfall (mm)	Soil temperature (Cº) Average	Wind speed (Km Per hour)
	Max	Min	Max	Min			
January	19.18	4.26	75.80	35.24	27.43	7.03	2.9
February	21.69	7.29	77.39	42.23	37.72	9.14	3.2
March	28.20	12.06	75.38	35.23	37.17	13.89	3.5
April	34.74	17.94	66.12	29.42	36.54	19.02	5.2
May	38.32	22.33	59.66	30.73	31.6	21.87	5.4
June	39.50	25.9	59.96	32.89	74.24	25.78	5.5
July	38.44	25.76	73.33	38.76	121.6	26.77	5.2
August	36.66	25.29	75.68	42.61	108.3	26.37	4.1
September	35.47	21.95	77.21	39.29	61.58	23.49	3.7
October	32.33	16.79	71.55	35.51	15.13	20.09	3.5
November	26.71	10.01	71.56	36.66	5.80	14.10	3.2
December	21.93	5.67	75.20	35.90	15.38	8.96	3.1
Mean	31.1	16.27	71.57	36.21	47.71	18.04	4.04

Source: Agricultural research farm Ahmad Wala Karak.

3. RESULTS

The arrangement of plant life record is commonly vegetation orientation and main query disquiets the classification and explanation of the vegetation in addition to inconsistency of ecological arrangement. Distinctive multivariate techniques are generally fruitful and commonly used for plant life arrangement position. Though, distinctive multivariate analyses do not directly take into explanation relations in their computation and are not particularly designed to vegetation structures rationalization. The ordination may be defined as the position of communities designed to set apart group types, location, relative position, standing of communities in a season of particular area. In other words, the ordination is the sound or clear arrangement of split communities or species in a season of a particular area. In present work the ordination of communities in summer is given as follows:

3.1 Hierarchical Cluster Analysis

In summer season, 22 communities were analyzed for ordination by Cluster Analysis and DCA. The Hierarchical Cluster Analysis shows that the relationship among 22 communities during summer were inclusive into 21 cluster cycling where in cycle 1 it shows the relationship of 2 communities at 4.6423E-02 and last i.e. cycle 21, 22 communities were connected with one another at 3.9256E+00 as well as 0.66 % chaining. Furthermore, it marked out distinct five groups by different level, cycling and similarity of communities. The picture of each one group is as below:

3.1.1 *Cenchrus-Saccharum-Prosopis* association

The group 1 consists of *Eragrostis-Calotropis-Prosopis* community (ECP), *Phoenix-Saccharum-Cenchrus* community (PSC)*, Aerua-Prosopis-Saccharum* community (APS) and *Tribulus-Tamarix-Saccharum* community (TTS) which raised at 1.5117E+00 in cycles 14. It composed of 28 plant species consisted of 6 trees, 6 shrubs and 16 herbs. The dominant plant species on the basis of important value *Cenchrus biflorus* (IV = 29.2), *Saccharum bengalense* (IV = 25.5) and *Prosopis farcta* (IV = 24.3) (Table 2; Fig. 2).

3.1.2 *Cenchrus-Eragrostis-Calligonum* association

Group 2 consists of 26 species of 4 tree, 5 shrubs and 17 herbs. *Eragrostis-Saccharum-Zizyphus* community (ESZ), *Calligonum-Cenchrus-Zizyphus* community (CCZ), *Tribulus-Acacia-Saccharum* community (TAS) and *Calligonum-Tribulus*-Zizyphus community (CTZ) made the association at 6.2210E-01 in cycles 8. The mean highest important value was covered by *Cenchrus biflorus* (IV = 29.7), *Eragrostis poaoides* (IV = 26.6), *Calligonum polygonoides* (IV = 26.14) (Table 2; Fig. 2).

3.1.3 *Zizyphus-Cenchrus-Eragrostis* association

Zizyphus-Cenchrus-Saccharum community (ZCS), *Saccharum-Zizyphus-Cynodon* community (SZC) and *Eragrostis-Zizyphus-Capparis* community (EZC) formed the 3rd group of association at 8.7080E-01 in cycles 10. . It composed of 27 species included 3 tree, 9 shrub and 15 herb species. The dominant plant of association were *Zizyphus maurtiana* (IV = 51.25), *Cenchrus biflorus* (IV = 33.88) and *Eragrostis poaoides* (IV = 32.44) (Table 2; Fig. 2).

3.1.4 *Rhazya-Fagonia-Cymbopogon* association

Rhazya Fagonia Cymbopogon association becomes visible in the form of 4rth group at 1.9213E+00 in cycle 16 that consists of 5 communities i.e. *Cymbopogon-Rhazya-Zizyphus* community (CRZ), *Fagonia-Rhazya-Zizyphus* community (FRZ), *Cenchrus-Cassia-Zizyphus* community (CCZ), *Cleome-Phoenix-Capparis* community (CPC) and *Tribulus-Periploca-Zizyphus* community (TPZ). The mean highest IV was attained by *Rhazya stricta* (IV = 32), *Fagonia cretica* (IV = 29.2) and *Cymbopogon jwarancusa* (IV = 25.7). Moreover, 33 plants consisted of 7 tree, 10 shrub and 16 herb species were present (Table 2; Fig. 2).

3.1.5 *Aerua-Boerhavia-Zizyphus* association

Saccharum-Cymbopogon-Zizyphus community (SCZ), *Capparis-Aerua-Acacia* community (CAA), *Aerua-Acacia-Capparis* community (AAC), *Boerhavia-Acacia-Capparis* community (BAC) and *Boerhavia-Zizyphus-Capparis* community (BZC) formed the group 5 at 2.1408E+00 during cycle 17. It composed of 26 species contained 5 trees, 9 shrubs and 12 herbs. The mean highest IV represented by *Aerua persica*, *Boerhavia diffusa* and *Zizyphus maurtiana* were 41.8, 26.5 and 21.87 respectively (Table 2; Fig. 2).

Table 2. Mean relative importance value of species in different associations during summer distinguished through cluster analysis of Tehsil Takht-e-Nasrati, Karak

S. No	Species name	Groups				
		1	2	3	4	5
1	*Acacia modesta* Wall.	0	0	0	7.2	21.37
2	*Acacia nilotica* (L.) Delice.	3.92	10.03	4.34	4.38	2.82
3	*Dalbergia sissoo* Roxb.	2.32	5.17	5.91	0.68	2.01
4	*Gymnosporia royleana* Wall. ex M. A. Lawson.	0	0	0	0.93	0
5	*Monotheca buxifolia* (Falc.) A.D.	0	0	0	1.09	0
6	*Phoenix dactylifera* L.	12.2	2.99	0	6.19	0
7	*Prosopis juliflora* (Sw.) DC.	0	0	0	0	1.04
8	*Prosopis farcta* (Banks & Sol.) J.F. Macbr.	24.3	0	0	0	0
9	*Tamarix aphylla* (L.) Karst.	1.4	0	0	0	0
10	*Zizyphus maurtiana* Lam.	12.3	15.68	51.25	17.6	21.87
11	*Astragalus psilocentros* Fisch.	0	0	2.07	0.73	16.14
12	*Calligonum polygonoides* L.	0	26.14	3.38	0	0
13	*Calotropis procera* (Wild) R.Br.	16.4	6.18	7.76	3.7	2.54
14	*Capparis decidua* (Forssk.) Edgeworth.	0	0	9.3	7.2	16.11
15	*Capparis spinosa* L.	0	0	0	0	20.53
16	*Cassia angustifolia* Vahl.	0	0	0	7.14	0
17	*Datura metel* L.	6.22	1.72	4.22	0	0
18	*Periploca aphylla* Decne.	10.1	6.84	4.5	6.9	0
19	*Punica granatum* L.	0	0	0	0	7.74
20	*Rhazya stricta* Decne.	0	0	2.98	32	9.52
21	*Ricinus communis* L.	2.2	0	0	0	0
22	*Saccharum bengalense* Retz.	25.5	18.02	22.66	3.37	11.4
23	*Saccharum spontaneum* L.	12.6	0	0	5.64	0
24	*Withania coagulans* (Stocks)	0	0	0.91	10.8	1.79

	Dunal.					
25	*Zizyphus nummularia* (Burm.f.) W. & A.	0	0	0	6.71	3.89
26	*Aerua persica* (Burm.f.) Merrill.	16	2.48	2.31	4.3	41.8
27	*Boerhavia diffusa* L.	8.81	12.69	16.46	10.8	26.5
28	*Cenchrus biflorus* Hook. f.	29.2	29.7	33.88	15.7	6.7
29	*Chrozophora obliqua* (Vahl.) A. Juss.	6.32	6.54	0	0	0
30	*Citrullus colocynthis* L. Schrad.	0	6.91	9.06	0	0
31	*Cleome viscosa* L.	0	0	0	8.13	0
32	*Cymbopogon jwarancusa* (Jones) Schult.	0	5.12	0	25.7	10.33
33	*Cynodon dactylon* (L.) Pers.	5.6	5.7	13.86	15.1	18.17
34	*Cyperus esculentus* L.	18	8.11	3.1	4.6	16.74
35	*Cyperus rotundus* L.	7.16	14.65	17.66	7.8	4.51
36	*Echinops echinatus* Roxb.	0	5.15	1.48	3.42	2.22
37	*Eragrostis poaoides* Beauv.	22.4	26.6	32.44	17.5	7.84
38	*Euphorbia hirta* L.	7.3	21.49	9.01	0	0
39	*Euphorbia prostrata* Ait.	3.8	15.87	14.38	5.6	0
40	*Fagonia cretica* L.	9.66	7.47	7.96	29.2	4.6
41	*Heliotropium europaeum* L.	8.53	11.61	0	2.69	0
42	*Launaea nudicaulis* (L.) Hook. f.	0	0	3.53	0	0
43	*Peganum hermala* L.	5.52	0	0	0	0
44	*Salvia moorcroftiana* Wallich ex Benth.	0	0	0	4.4	0
45	*Solanum surattense* Burm .f.	3.04	1.63	5.81	11.9	3.52
46	*Tribulus terrestris* L.	19.2	25.51	9.78	10.9	18.3

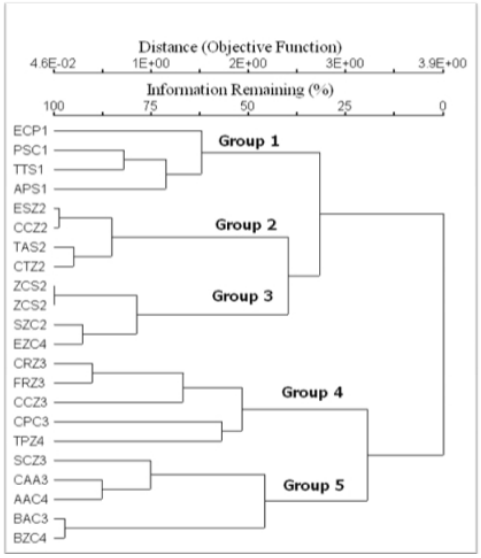

Fig. 2. Two way cluster dendrogram showing grouping of different communities into association during summer, Tehsil Takht-e-Nasrati, District Karak

3.2 Detrended Correspondence Analysis (DCA)

Ordination of the communities in summer by DCA explains that 5 groups i.e. 1, 2, 3, 4 and 5 on the basis of DCA weight on Axis 1 and 2, with different weight were formed that comprises 5, 3, 2, 5 and 2 communities respectively. On axis 1, Groups 1, 2, 3, 4 and 5 were structured with DCA mean weight 171.2, 136.7, 70, 40.3 and 14.5 at EIG 0.385 respectively. High DCA weight (244) in BAC and low (0) in ECP was present on Axis 1. On axis 2, the mean DCA weight of Groups i.e. 1, 2, 3, 4 and 5 were found as 106.2, 65, 120, 57.67 and 5.5 respectively while the highest DCA weight (168) was found in ECP and low (0) in ZCS at EIG (0.157). The communities that were not present in any groups were BAC, BZC, CRZ, APS and ECP with DCA weight 244, 224, 192, 64 and zero respectively on Axis 1. These groups show different vegetation types during summer seasons (Fig. 3).

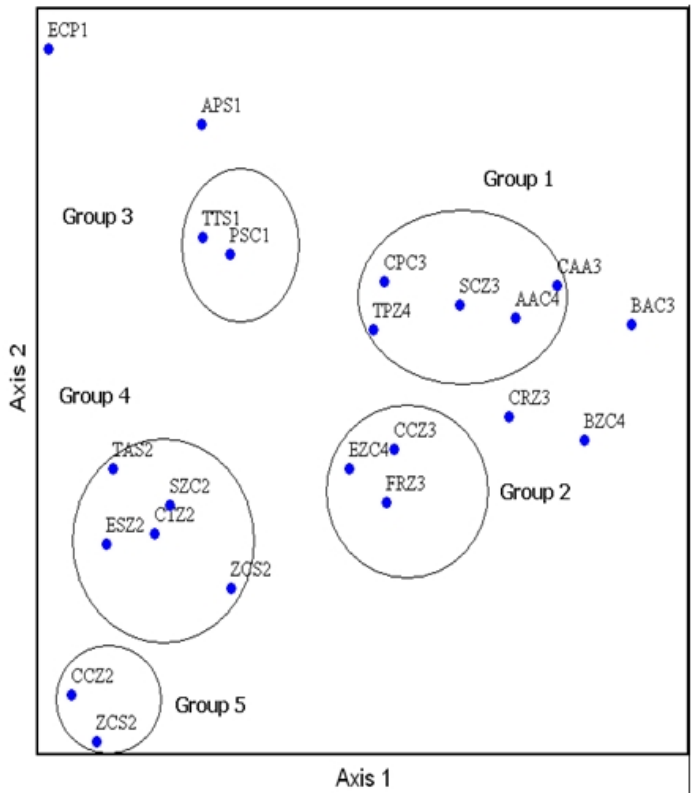

Fig. 3. Detrended Correspondence Analysis (DCA) of communities during summer, Tehsil Takht-e-Nasrati, District Karak

4. DISCUSSION

Cluster analysis segregates the communities of similar character into major groups of plant life. In summer 5 groups were structured. The chaining percentage would be high with high quantity and presence of species in an area. In spring, species were mostly found in all sites in less or high quantity while in summer, species presence is restricted to specific area due to diverse factors. Most factors that occur during summer in investigated area were high grazing, cutting, non availability of water, soil erosion and uprooting of plant species. Author

[1] analyzed natural vegetation of two zones along Hanna Lake, Baluchistan using DECORANA and classify the vegetation into plant communities. Major group is the objective to give structure to plant life. However, cluster analysis is a helpful preliminary position for competent judgment and adjoining neighbors of vegetation. Greater the homogeneity within communities and greater will be the similarity in the clustering. The cluster analysis was used to give clear picture of the plant life in an area in the form of tree-shape. In hierarchical clustering the principle is to structure a hierarchical chain of communities' groups sorting from groups of community position at the bottom to a comprehensive group at the top. The graphically diagram which represents the hierarchy in the structure of upturned tree expresses a dendogram that clarifies the arrangement in which position were united (bottom-up outlook) or group were divide (top-down outlook).

Detrended Correspondence Analysis (DCA) was used to give the shape to the communities on the basis of weight. This method is also used to give cleared picture of plant life in specific area in different seasons. The present results concluded that the plant species composition was different in different seasons in the same area. On axis 1, in summer, the DCA weight was low in plain area because plants are restricted to specific sites due to environmental condition. However, DCA has limitations, making it best to remove extreme outliers and discontinuities prior to analysis. DCA consistently gives the most interpretable ordination results, but as always the interpretation of results remains a matter of ecological insight and is improved by field experience and by integration of supplementary environmental data for the plant life sample sites. Author [5] applied the Detrended Correspondence Analysis (DCA) to identify environmental gradients to define vegetation distribution in green belts, gardens and parks of Islamabad city and classified the flora into 4 major association groups. Author [8] studied the vegetation at Hail region north of central Saudi Arabia where multivariate techniques results showed 7 vegetation groups. Author [3] analyzed the vegetation along motorway (M-2), Pakistan by using multivariate techniques. The author [25] recommended that if plants species or communities turnover is larger than 1.9 standard deviation then DCA technique is advanced option of ordination. Detrended Correspondence Analysis (DCA) was carried out to express compositional ascents in the plant life. DCA was presented using a default value for rescaling and detrending. Rare species and divergent communities were down weighted in DCA ordination. The different association produced by cluster analyses in different seasons are designed a first two axes as a sprinkled diagram. The DCA ordination axes may signify in same way the main substrate weight that affect the community in these records and have been used by the community and area characteristic of the relationship to argue the dominant characteristics of the location and plant life association. Cluster and DCA analysis are very helpful in communities' and species classification in addition to give structure to plant life. Such type of study was also carried out by [21] who stated that tree density, pH and soil texture were the major determinant of vegetation pattern. There was thin vegetation in the investigated area and species was present in patches. The ecologists have tried to quantify the division of species beside the ecological gradients. There is an association between plant life sample and resources available [2,12].

Our result agrees with [6] who stated that altitude is an environmental factor which affecting plants association. Plant ecologists have commonly been aware that plant life shows an inconsistency over a wide range of particular scales and area that have built up methods for studying the classification of vegetation. The area show less rainfall than 200 mm and consist of thorny trees like *Zizyphus spp, A. nilotica*, *A. modesta*. Trees are sprinkled, roots longs, leaves thick and small in most plant species therefore, the investigated area fall into tropical thorn forests. The value of altitude as an ecological factor affecting plant species

association is not considering, surprising its close correlation with precipitation and interruption of rain [23,24]. Authors [17,26,27] conducted a study to work out the relationship between remote sensing data and vegetation communities of ecological importance using multivariate techniques and stated that the ordination methods proved effective in summarizing basic, general structure of the plant community types and to some extent indicated correspondence with their spectral signatures. This study pointed out that the climatic environment of region has restricted enlistment of area and the plant life was changed with the change of seasons and altitude.

5. CONCLUSION

Multivariate techniques methods are used as a perfect way to study and helps skillfully in evaluating the biodiversity and conservation of intact habitat and plant life in specific area. This study pointed out that climatic environment of region has privileged conscription of area and association of plant was changed with the change of altitude. Plant ecologists have commonly been conscious that vegetation shows a discrepancy over a broad variety of particular scales and area. Therefore, it is needed that we apply the multivariate techniques methods for studying the degree of plant life distinction.

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COMPETING INTERESTS

The authors declare that they have no competing interests.

REFERENCES

1. Ahmad SS, Yasmin T. Vegetation classification along Hanna lake, Baluchistan using ordination techniques. Pak. J. Bot. 2011;43(2):863-872.
2. Ahmad SS, Fazal S, Valeem EE, Zafar I. Evaluation of ecological aspects of road side vegetation around Havalian city using multivariate techniques. Pak. J. Bot. 2009;41(1):461-466.
3. Ahmad SS, Wahid A, Akbar KF. Multivariate classification and data analysis of vegetation along motorway (M-2), Pakistan, Pak. J. Bot. 2010;42(2):1173-1185.
4. Ahmad SS. Ordination and classification of herbaceous vegetation in Margalla Hills National Park Islamabad Pakistan, Biological Diversity and Conservation, Biol. Divers. Cons. 2009;2(2):38-44.
5. Ali SM, Malik RN. Spatial Patterns Of Vegetation With Underlying Soil Properties Prevailing Along Drain Side Areas In Islamabad City. Pak. J. Bot. 2010;42(4):2397-2410.
6. Dasti AA, Malik SA. A transect of vegetation and soils on the Indus valley scarp slope, Pakistan. Pak J. Plant Sci. 1998;4(2):73-84.

7. El-Bana M, Shaltout K, Khalafallah A, Mosallam H. Ecological status of the Mediterranean *Juniperus phoenicea* L., relicts in the desert mountains of North Sinai, Egypt. Flora-Morphology, Distribution, Functional Ecology of Plants. 2010;205(3):171-178.
8. El-Ghanim WM, Hassan LM, Galal TM, Badr A. Floristic composition and vegetation analysis in Hail region north of central Saudi Arabia. Saudi J. Biol. Sci. 2010;17:119-128.
9. He MZ, Zheng JG, Li XR, Qian YL. Environmental factors affecting vegetation composition in the Alxa Plateau, China, J. Arid Environ. 2007;69(3):473-489.
10. Hill MO. TWINSPAN - a FORTRAN Programme for arranging multivariate data in an ordered two-way table by classification of the individuals and attributes. Cornell University, Department of Ecology and Systematic, Ithaca, New York; 1979.
11. Hussain F. Field and laboratory manual of plant ecology. UGC. Islamabad; 1989.
12. Jabeen T, Ahmad SS. Multivariate analysis of environmental and vegetation data of Ayub National Park, Rawalpindi. Soil and Environment. 2009;28(2):106-112.
13. Khan M. A Fraction of the Angiosperms of Tehsil Banda Daud Shah." M.Sc thesis. Gomal University D. I. Khan, Khyber Pakhtun Khawa, Pakistan; 2004.
14. Khan M. Dimension and Composition of plant life in Tehsil Takht-e-Nasrati, district Karak, Khyber Pakhtun Khawa, Pakistan. Ph.D. thesis, Department of Botany, University of Peshawar, Khyber Pakhtun Khawa, Pakistan; 2012.
15. Khan M. Hussain F. Plant life classification in winter of Tehsil Takht-e-Nasrati, District Karak, Khyber Pakhtun Khawa, Pakistan. ARPN Journal of Science and Technology. 2012;2:113-124.
16. Khaznadar M, Vogiatzakis IN, Griffiths GH. Land degradation and vegetation distribution in Chott El Beida wetland, Algeria, J. Arid Environ. 2009;73(3):369-377.
17. Malik RN, Hussain SZ. Linking remote sensing and ecological vegetation communities: a multivariate approach. Pak. J. Bot. 2008;40(1):337-349.
18. McCune B, Mefford MJ. Multivariate analysis of ecological data. Version 4.16. MJM software, Oregon, USA; 1999.
19. Nasir E, Ali SI (eds.). Flora of West Pakistan. Fakhri Press, Karachi; 1972.
20. Sagers LC, Lyon J. Gradient analysis in a riparian landscape: contrasts among forest layers. For. Ecol. Manage. 1997;96:13-26.
21. Saima S, Dasti AA, Hussain F, Wazir SM, Malik SA. Floristic compositions along an 18 - km long transect in Ayubia National Park district Abbottabad, Pakistan. Pak. J. Bot. 2009;41(5):2115-2127.
22. Stewart RR. An Annotated Catalogue of the Vascular Plants of West Pakistan and Kashmir.Gordon College, Rawalpindi; 1972.
23. Danin A, Orshan G, Zohary M. The vegetation of the northern Negev and the Judean Desert of Israel. Israel J. Bot. 1975;24:118-172.
24. Evenari M. Shanan L, Tadmore N. The Negev: the challenge of a desert. Harvard Univ. Press, Cambridge, M.A; 1982.
25. Jongman RHG, Ter Braak CJF, Van Tonggren OFR. Data Analysis in Community and Landscape Ecology. Purdoc, Wageningen, Netherlands; 1995.
26. Dasti AA, Saima S, Athar M, Attiq-ur-Rahman, Malik SA. Botanical composition and multivariate analysis of vegetation of Pothowar plateau, Pakistan. Journal of Botanical Research Institute of Texas. 2007;1:557-568.

27. Dasti AA, Saima S, Mahmood Z, Athar M Gohar S. Vegetation zonation along the geological and geo-morphological gradient at eastern slope of Sulaiman Range, Pakistan. African Journal of Biotechnology. 2010;9:6105-6115.

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