IOSR Journal of Pharmacy and Biological Sciences (IOSR-JPBS)
e-ISSN: 2278-3008, p-ISSN:2319-7676. Volume 9, Issue 1 Ver. VI (Feb. 2014), PP 54-59
www.iosrjournals.org

Multivariate Analysis Of Vegetation In Wet Temperate Forests Of Pakistan

Ramiz Raja, Tasveer Zahra Bokhari, Uzma Younis and Altaf Ahmad Dasti
Botany Division, Institute of Pure & Applied Biology, Bahauddin Zakariya University, Multan, Pakistan

Abstract: *The present investigation focuses on the floristic composition in wet temperate forests of Pakistan. This area was selected as it has variation and diversity i.e. downward the tropical thorn forests and upward the alpine meadows. Wet temperate forest has high diversity of vulnerable plant species. It is situated in the Galiat Forest plants division of Abbottabad between 34◦-1' to 34◦-3.8' N latitude and 73◦-2222.8' to 73◦-27.1' E longitude over an area of about 1684 hectares. Five hierarchy levels of classification of 27 sites were analyzed by (DCA). Four plant associations were recognized on the basis of cluster analysis. Deterended Correspondence Analysis (DCA) and Correlation Coefficient to detect the relationship between altitude and some environmental factors with the composition and structure of plants communities. The major families were Rosaceae, Pteridaceae, Pinaceae, Lamiaceae and Asteraceae.*

I. Introduction

Pakistan is a sub-tropical country which is situated between 20 and 37° N latitude 75° E longitude. Ayubia national park lies in the Himalayan wet temperate forest. Ayubia National Park is a protected area of 3,312 hectors (8,184 acres) located in Abbottabad District, Khyber Pakhtunkhaw province, northern Pakistan. It was declared a national park in 1984. The area supports temperate forest and temperate and broad mixed forest eco-region habitats, with an average elevation of 8,000 feet (2,400 m) above the sea level. Ayubia National Park is surrounded by seven major villages and four small towns of Thandiani, Nathiagali, Ayubia and Khanspur. Here precipitation may sometimes exceed 600mm, the making of these montane forests a sort of enclave in which the plants and diversity of natural sites make it a sort of bio-geographical crossroad between the sub-montane and alpine meadow vegetation [1]. For the temperate species the knowledge of habitat association is limited [2]. These forests are most attractive in the Himalayas with varying degree of coniferous species including *Abies pindrew, Pinus wallichiana, Taxus wallichiana, and Cedrus deodara* with varying admixture of evergreen and deciduous patches of broad leaved forests. After the snow melts, a variety of ferns being the first to develop in the spring season, followed by a variety of perennial species. There is also a good deal of mosses and lichen on the tree trunks [1]. The impact of snow pressure and strong winds on vegetation structure and species composition in expected at high altitude [3-10]. Chemistry of soil is influenced by the vegetation while the composition, physiognomy, productivity and its communities is influenced by soils [11]. The vegetation of the study area is dominated by conifers species, principally pine and fir with scattered individuals broad leaves trees, i.e.; oak [12]. The primary objective of this study is to explore the factors that determine the boundaries and composition of plant communities on the wet temperate forest of Ayubia National Park.

II. Materials And Methods

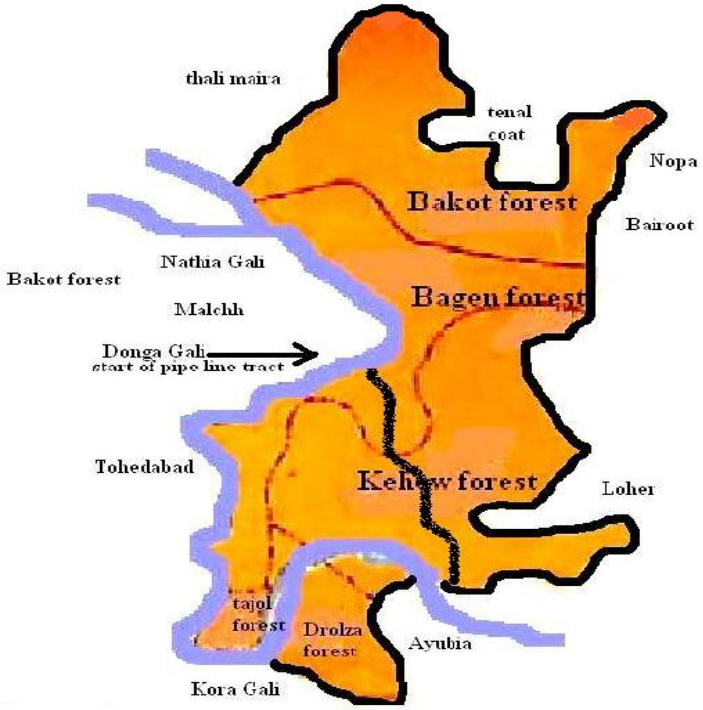
The study work was conducted durin March 2010. The present work reported wild plants of wet temperate vegetation of Ayubia National Park, Pakistan. All these plants were collected, identified and dried and then preserved with the help of flora of Pakistan [13 & 14]. The next step was to deposit the voucher specimen in herbarium Pure and Applied biology B.Z.U Multan for further reference.

Study area

The study area is a 4 km long path along the water pipeline between Dunga Gali and Ayubia (Figure 1).The study area is located in the core of wet temperate sub Himalaya coniferous forests (34°-1 to 34°-3.8 N latitude and 73°-22.8 to 73°-27.1 E longitudes). The overall altitude of the area is 2900m a.s.l. The area is of about 1684 hectares [15]. Mean rainfall vegetation is about above 1,500mm, mean annual temperature is 21°C and relatively humidity is about 66% . It is contended that the highly unique and endemic macro fungal biodiversity is being pushed towards local extinction and many new species are established to the detriment of the native ones The sites for sampling were choosed keeping in mind having maximum possible heterogeniety in vegetation. These sites were found along the the increasing altitude from South to North of Yubia national park. The average winter accumulation of snow is about 660 cm [16 & 17]. A single transect was used instead of discrete plots as continuous sampling allows comparison of spatial variation between data sets, and assesment

of weather turnover is spatially or occur more radily at certain points [18]. Systematic record of vegetation parameters was taken in 4 km long transects. At each kilometer, 100 m² stands were established.

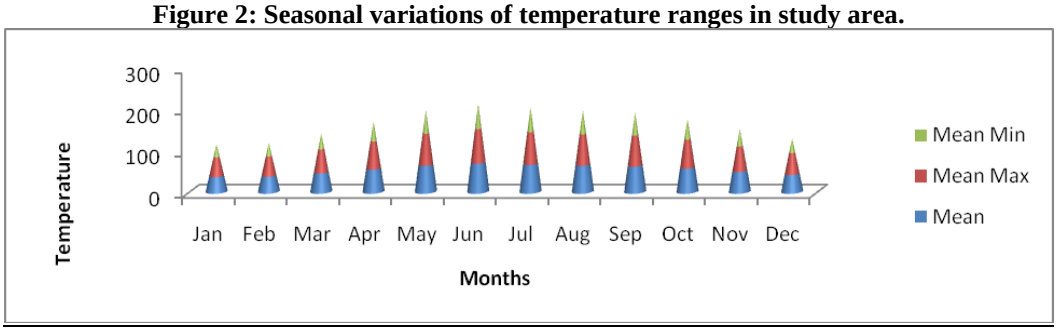
Figure 1: Map of Ayubia National Park showing the study area Pipeline.



Climate

The climate of the area is little hot in summer with the influence of monsoons with a very mild and pleasant summer (Figure 2). In winter it is severe cool. The snow season prevails from mid December to mid March. The minimum temperature in winter months falls well below the freezing point. The park remains snow-capped through the later part of winter. The mean annual rainfall is well above 1500mm in addition to precipitation received in the form of deep snow in winter. Most of the rainfall is received during monsoon period from July to August, while it remains only placidly hot in May and June and the driest months are September and October. Throughout the area, the precipitation is derived from the south-west monsoon and fall during July to September. The variation in rainfall from year to year is appeared to be the general characteristic of the sub-continent and particularly the study area.

Figure 2: Seasonal variations of temperature ranges in study area.



III. Results

Floristic composition

During field survey 44 species belonging to 30 families were recorded (Table 1).. The major families were Rosaceae, Pteridaceae, Pinaceae, Lamiaceae, and Asteraceae. The other families contributed a good share in the flora. In gymnosperms two families were recorded. Among these families Pinaceae with 3 genera was dominant and Taxaceae with one genera only. In angiosperm 1 monocotyledon and 26 dicotyledons families were recorded. Among monocotyledons ony Poaceae present while in dicotyledons Rosaceae with 5 genera was dominant while Asteraceae, Brasicaceae, Caperifolaceae, Fabaceae and Lamiaceae having 2 genera. Faimilies

like Arliaceae, Amaranthaceae, Berberidaceae, Crassulaceae, Gerniaceae, Hippocastanaceae, Malvaceae, Oleaceae, Primulaceae, Plantagnaceae, Polygunaceae, Taxaceae, Velerianaceae and Violaceae have little share in the flora.

Table 1: Scientific names and families with some of the features like flower color and life forms.

Sr. No.	Species	Family	F. color	Life form
1	*Abies pindrow* Royle	Pinaceae	--	Tree
2	*Adiantum venustum* D. Done	Adiantaceae	--	Herb
3	*Aesculus indica* Coleber	Hippocastanaceae	--	Tree
4	*Ajuga parviflora* Bth	Lamiaceae	P	Herb
5	*Androsace foliosa* Dcne-ex Duby	Primulaceae	P	Herb
6	*Berberis ceratophylla* G.Don	Berberidaceae	Y	Shrub
7	*Berginia ciliata* (Haw.)Sternb	Saxifragaceae	P	Herb
8	*Cedrus deodara* Roxb, ex Lamb	Pinaceae	--	Tree
9	*Celosia argentea* L.	Amaranthaceae	P	Herb
10	*Chrysanthemum leucanthemum* Lin.	Asteraceae	--	Herb
11	*Dryopteris fragilis* L.	Dryopteridaceae	--	Herb
12	*Euphorbia wallichii* HK.F	Euphorbiaceae	GY	Herb
13	*Fragaria indica* (Andr.)	Rosacae	Y	Shrub
14	*Geranium nepalense* Sweet	Geraniaceae	W	Herb
15	*Hedera nepalensis* K. Koch	Araliaceae	GY	Climber
16	*Iberis amara* Lin.	Brassicaceae	--	Herb
17	*Indigofera geradiana* Wall.ex Baker	Fabaceae	P	Shrub
18	*Jasminium humile* L.	Oleaceae	Y	Climber
19	*Lonicera quiniquielocularis* Hardw	Caprifoliaceae	YW	Climber
20	*Malvastrum cormandelianum* L.Garcke	Malvaceae	Y	Herb
21	*Neslia apiculata Fisch.*, C.A.Lall	Brassicaceae	--	Herb
22	*Pinus wallichiana* A.B. Jadcson	Pinaceae	--	Tree
23	*Plantago lanceolata* L	Plantaginaceae	W	Herb
24	*Plectranthus rugosus* Wall. Ex Bth.	Lamiaceae	P	Herb
25	*Populus ciliata* Wall. ex Royle	Salicaceae	G/Y	Herb
26	*Prunus cornuta* (Wall.exRoyle) Steud	Rosacae	W	Tree
27	*Pteris cretica* L.	Pteridaceae	--	Herb
18	*Pteris vttata* L.	Pteridaceae	--	Herb
29	*Quercus baloot* Griffith	Fagaceae	G/Y	Tree
30	*Ranunculus laetus* Wall. Ex. H & T	Ranunculaceae	Y	Herb
31	*Rosa macrophylla* Lindlo	Rosacae	W	Climber
32	*Rubus ellipticus* Smith	Rosacae	P	Shrub
33	*Rumex acetosa* L	Polygonaceae	G	Herb
34	*Sedum oreades* (Decne.) Raym.Hamet	Crassulaceae	P	Herb
35	*Spiraea vaccinifolia* D.Don.	Rosacae	W	Herb
36	*Stipa jacquemonti* J S	Poaceae	--	Herb
37	*Taraxacum offinalis* Wigg.	Asteraceae	Polymer Phic Y	Herb
38	*Taxus wallichiana* Zucc.	Taxaceae	--	Tree
39	*Trifolium repens* L	Fabaceae	Y	Herb
40	*Tulipa spp.*	Poaceae		Herb
41	*Valeriana jatamansi* Jones	Valerianaceae	W	Shrub
42	*Verbascum thapsus* L	Scrophulaiaceae	Y	Herb
43	*Viburnum continifolium* D.Don.	Caprifoliaceae	W	Shrub
44	*Viola canescens* Wall	Violaceae	Violet	Herb

Key:

W	=	White	P	=	Pink
G/Y	=	Greenish Yellow	V	=	Violet
Y	=	Yellow	YW	=	Yellowish white

Cluster analysis

On the basis of normal cluster analysis four plant associations have been recognized by specifying four levels of division (Figure.3). Four plant associations with different botanical composition were recognized on the basis of cluster analysis (Table 1). Most noticeable feature indicated by multivariate analysis was the separation of the less wooded sites (stands belonging to D) from over-wooded stands (stands belonging to A-C). The application of hierarchical cluster analysis to all the data revealed that samples 4 (association D) was separated from other samples at first level by *Ajuga parviflora*, *Iberis amara*, and *Trifolium repens.* The stands belonging to disturb site (association B) separated from the communities of undisturbed sites (association A and C) at level two by *Aesculus indica*, *Indigofera gerardiana* and *Lonicera quiniquielocularis.* The third

hierarchical level separated the association C with *Euphorbia wallichii,* and *Iberis amara* from the association C. As a result of three hierarchical levels four communities in the mountain complex were recognized.

1. Association A (Pinus wallichiana, Abies pindrow)

This association is distributed above 2280 and extends up to 2288 meter or little higher at appropriate places. This association represents major vegetation type of the mixed coniferous forest. It represents a varying mixture of coniferous tress of habitually fine growth, *Abies pindrow, Pinus wallichiana* with varying mixture of ever green and decidous broad leaf trees such as *Quercus baloot*. The soil of this association is characterized by having highest Electric conductivity (3.38dSm-1) and Phosphorus (10.62ppm) then any other association. This soil having lowest organic matter (0.75 %) saturation percentage (34.500 %) and altitude (2283.50) then any other association.

2. Association B (Pinus wallichiana , Geranium nepalense)

This association is distributed above 2282 meter and extends up to 2300 meter or slightly higher at appropriate places. The component species of this association such as, *Dryopteris fragilis, Fragaria indica, Geranium nepalense, Viola canescens and Pinus wallichiana* , generally occur on the damp to wet soils mainly in the damp woods or the edges of streams. The soil of this association is characterized by having highest value of litter (84.00 %) than any other association recognized by Normal Cluster Analysis.

3. Association C (Abies pindrow, Pinus wallichiana)

This distribution is distributed above 2283 meter and extends up to 2350 meter, above the sea level. The cover in this association is naturally complete but not very dense. The first strata was composed of tree layer which include *Pinus wallichiana, Taxus wallichiana, Abies pindrow Populus ciliate, Quercus baloot, , Aesculus indica* among these *Pinus wallichiana, Taxus wallichiana, Abies pindrow*, were found abundantly in this association. This soil of this association is characterized by having highest value of Potassium (292 ppm) than any other association recognized by Normal cluster analysis table (4.12). The soil of this association having also very high litter percentage (77.00 %).

4. Association D (Fragaria indica, Plectranthus rugosus)

This association is distributed about 2285 meters and extends above 2310 meters above the sea level and little higher on the exposed ridge at appropriate places. This association generally avoids the heavier soils or badly drained soils. The soil of this association is characterized by having highest value of organic matter (0.81 %), saturation percentage (38.444 %) and Bare percentage (32.22 %) than any other association recognized by Normal Cluster Analysis table (12.4).

Figure 3: The Hierarchy of classification of 27 samples by Normal Cluster analysis. The number of samples in each group is given.

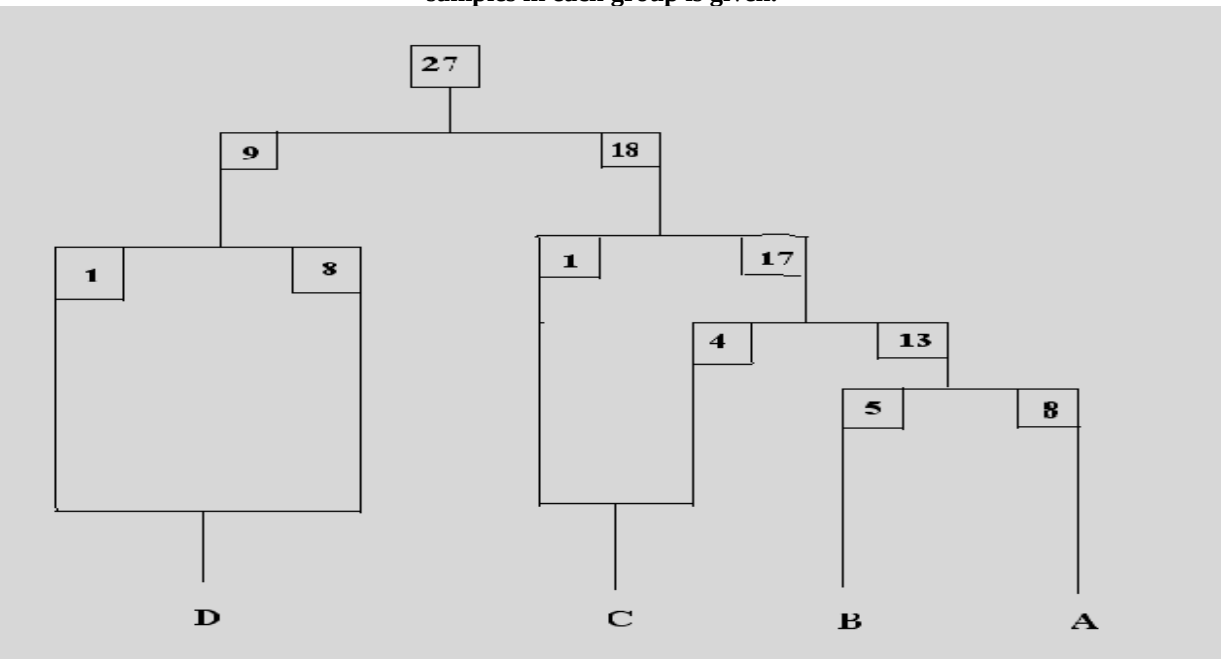
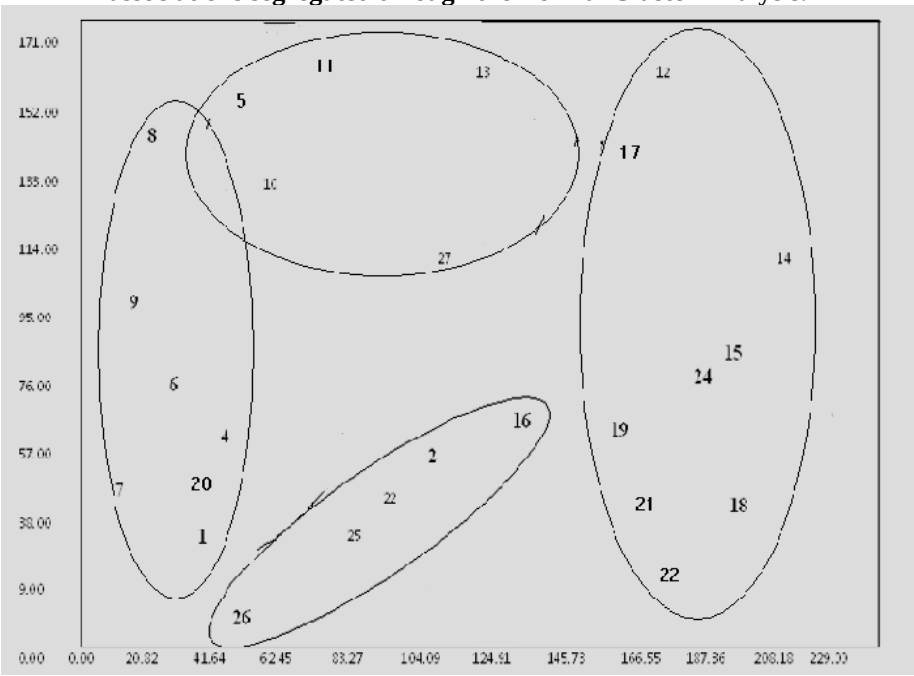


Figure 4: The DECORANA (axis 1 and 2) plot of the 27 samples (sites) of Ayubia National Park. Stands are not plotted individually, instead sites are shown. The circle indicate the boundaries of four associations segregated through the Normal Cluster Analysis.



Gradient analysis

All the data set were analyzed using DCA. Eigen values for the first four DCA axes were 0.332 and 0.168, 0.095 and 0.083 respectively. The axis 1 and 2 showed significant correlations with soil attributes and altitude (Table 2) and no further use was made of the remainder of the axes. It was clear that this main ordination is along the Phosphorus and altitudinal gradient from the bottom and to the top of transect. Soil litter percentage showed a significant positive correlation ($P<0.05$) DCA axis 1. The DCA axis showed the strongest correlation with Phosphorus (-0.471) and EC (R=0.655). The both DCA axes 1 and 2 have significant correlation with many soil variables (Table 2).

Table 2: Spearman,s Rank Correlation Coefficients between DCA first and second axes scores, soil parameters and altitude for Ayubia National Park.

Facters	Axis 1	Axis 2
Electerical conductivity, dSm^{-1}	-0.328	0.655
Soil pH	0.053	0.171
Organic matter, %	0.259	0.127
Phosphorus, ppm	-0.471	-0.156
Pottassium, ppm	-0.303	-0.157
Saturation, %	0.101	0.070
Altitude	0.232	-0.201
Litter %	0.054	0.599
Bare %	0.066	0.218

IV. Discussion

In the study area the most of the edaphic factors included in the present work were associated with the distribution of the species. Phosphorus was significantly correlated with DCA axis 1 (Table 2) that determined the boundaries and the composition of the plant communities. The four associations produced by cluster analysis are plotted on first two axes as a scattered diagram (Figure 3 & 4). To discuss the overriding features of the environment the ordination axes may represent in some way the major substrate influenced which effect the stands in these data, and have been used the plant and soil characteristics of the association (Table 3). Summarizing the main findings, it may be concluded that both classification and ordination are able to delimit the plant association according to their environment.

A negative correlation between soil EC and altitude confirms the findings of Dasti and Malik [19] and Wazir *et al.,* [2] supports the assumptions that down slope movement of water cause mobilization of nutrients

and spatial variation in concentration and availability of these resources. The second DCA was significantly influenced by litter percentage.

Although there are important floristic differences between the rich and poor Litter percentage within a wet temperate zone. The litter cover percentage is rich at low EC site (association B) while it is decrease with the increase in altitude as we move towards the DCA axis II and Litter percentage is poor at High EC site (association C).

Table 3: Mean values and standard deviations (S.D.) for all soil variables for the four community types identified by the Normal Cluster Analysis.

Facters	A	B	C	D
Electerical conductivity, dSm^{-1}	3.83	2.04	3.72	2.21
Soil pH	7.7	7.6	7.6	7.7
Organic matter, %	0.75	0.76	0.76	0.81
Phosphorus, ppm	10.625	9.400	9.200	8.444
Pottassium, ppm	282.50	288	292	278.89
Saturation, %	34.500	35.200	36	38.444
Altitude	2283.50	2290.00	2290.20	2299.78
Litter %	63.75	84.00	77.00	45.56
Bare %	27.50	29.00	32.00	32.22

Refrences

[1]. S. Saima, A.A. Dasti, F. Husaain, S. M. Wazir and S. A. Malik. Floristic composition along an 18 – Km long transects in Ayubia National Park District Abbottabad, Pakistan, *Pak. J. Bot*., 41(5), 2009, 2115-2127.

[2]. S. M. Wazir, A. A. Dasti, S. Saima, J. Shah and F. Hussain. Multivariate analysis of vegetation of chapursan valley: an alpine meadow in Pakistan, *Pak. J. Bot*., 40(2), 2008, 615-626.

[3]. R. H. Marrs, J. Procter, J. Heaney and M. D. Moundford. Change in soil nitrogen mineralization and nitrification along an altitudinal transect in tropical rain forest in Costa Ric, *Journal of Ecology*, 76, 1988, 466-482.

[4]. A. Heaney and J. Proctor. Chemical elements in fitter at a range of altitude on Volean barva, costa Rice: Nutrients in Tropical Forest and Sawanna Ecosystems, (Ed): Proctor, J. Blackwell Scientific Publications, Oxford, 1989, 225-271.

[5]. M. Ahmed, T. Hussain, A. H. Sheikh, S. D. Hussain and M. F. Saddique. Phytosocialogy and structure of Himalayan Forest from different climate zones of Pakistan, *Pak. Jour. of Bot*., 38(2), 2006, 361-383.

[6]. J. A. G. Vazquez and T. J. Givinish. Altitudinal gragient in tropical forest composition, structure and diversity in the Sierra de Manantlan, Jalisco, Mexico, *Journal of Ecology*, 86, 1988, 99-1020.

[7]. E. V. J. Tanner, V. Kopos, S. Freskos, J. R. Healey and A. M. Theobald. Nitrogen and phosphorus fertilization of Jamican Montane forest and redundancy analysis (version 2.1). ITO-TNO, Wageningen, 1990.

[8]. T. Peer, J.P. Gruber, A. Millingard and F. Hussain. Phytosociology, structure and diversity of the steppes vegetation in the mountains of Northern Pakistan, *Phytocoenologia*, 37(1), 2007, 1-65.

[9]. T. Peer, A. Millinger, J. P. Ggruber and F. Hussian. Vegetation and altitude zonation in relation to the grazing in steppe lands of hindukush range, Paksitan, *Phytocoenologia*, 31, 2001, 477-498.

[10]. T. Z. Bokhari, M. Ahmed, M. F. Siddiqui and Z. Khan. Forest Communities of Azad Kashmir, Pakistan, FUUAST J. Biol. 3(1), 2013, 137-145.

[11]. T. Jabeen and S. S. Ahmad. Multiverient analysis of environmental and vegetation data of Ayub National Park Rawalpindi, *Soil & environ*, 28(2), 2009, 106-112.

[12]. G. Nasim, M. Ali and A. Shabbir. A study of genus Ramaria from Ayubia National Park, Pakistan, *Mycopath* 6 (1&2), 2008, 43-46.

[13]. S. I. Ali and Y.J. Nasir. (Eds.) 1990-1992. Flora of Pakistan. Nos. 191-193. Department of Botany, University of Karachi.

[14]. S. I. Ali and Y.J. Nasir. (Eds.) 1995-2008. Flora of Pakistan. Nos. 194-208. Department of Botany, University of Karachi.

[15]. R. Khanum and A. Gillani. Conservational status of plant seedlings in Ayubia National Paksitan, *Lyonia*, 8(1). 2005,

[16]. H. G. Champion, S. K. Seth and G. M. Khattak. Forest types of Pakistan. Pakistan Forest Institute, Peshawar, 1965.

[17]. F. Hussain and I. Ilahi. *Ecology and Vegetation of Lesser Himalayas Pakistan*. Jadoon Printing Press Peshawar, 1991.

[18]. H. Tuomisto, K. Ruokolainen, M. Agauilar and A. Sarmiento. Floristic patterns along a 43-km transect in an Amazonian rain forest, *Journel of Ecology*, 91, 2003, 743-756.

[19]. A. A. Dasti and S. A. Malik. A transect of vegetation and soil on the indus valley scarp slope, Pakistan, *Pakistan journal Plant science*, 4(2), 1998, 73-84.

[20]. M. R. A. Khan. Revised working plan for the Gallies Forest Division. NWFP Forestry Pre-investment Center. Peshawar Pakistan, 1998.