Global Journal of Science Frontier Research: C
Biological Science
Volume 15 Issue 2 Version 1.0 Year 2015
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

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By Musharaf Khan, Farrukh Hussain & Shahana Musharaf
Federal Government College Mardan, Pakistan

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GJSFR-C Classification : *FOR Code: 069999*

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I. Introduction

Ordination techniques are commonly used in phytosociology. This may be done either by arranging the points along the axis or by forming the disperse 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. Khan, (2013) stated that analysis of plant species data by Cluster analysis and DCA is used to express the reasons of vegetation"s changes. Ordination techniques are widely used by the ecologists to study the relationship between vegetation and environment. He *et al*., (2007) using the Detrended correspondence analysis in the Alxa Plateau of Inner Mongolia, China. Khaznadar et al., (2009) analyze the distribution of plants species and environmental factors. Ahmad, (2009) studied the herbaceous vegetation by TWINSPAN in Margalla Hills National Park, Islamabad, Pakistan. El-Bana *et al*., (2009) studied *Juniperus phoenicea* and associated vegetation at three mountains in Egypt by TWINSPAN and DCA analysis techniques. Jabeen and Ahmad, (2009) conducted a study to analyze the vegetation and environment data by PCOrd 5 and CANOCO 4.5 of Ayub National Park, Rawalpindi. Ahmad et al., (2010) conducted a study along motorway (M-2), Pakistan using multivariate techniques. Classification and ordination is an invaluable method for vegetation survey (ElGhanim *et al*., 2010). Khan and Hussain, (2012) studied classification and ordination distribution patterns in Tehsil Takht-e-Nasratti. 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 (Khan, 2013). In the present study, an effort has been made to investigate and analyse correlation of communities with key environmental factors. The particular objectives of present study include quantifying the vegetation Shahbaz ghari, District Mardan using Clustering and ordination techniques for upcoming conservation and providing base line data of ecological important area.

Author α: Department of Biological Science, Federal Government College Mardan, Pakistan. e-mail: k.musharaf@gmail.com
Author σ: Department of Biotechnology, Sarhad University of Science and Information Technology Peshawar, Pakistan.
Author ρ: Department of Chemistry, Government Girls Degree College, Sheikh Maltoon, Mardan, Pakistan.

II. Research Area

The district lies from 34°23"N 72°17"E. The elevation of the valley is 1000 to 2056m above sea level. The total area of the valley is 5 kilometers sq. Shahbaz Garhi is situated on the junction of three ancient routes i.e. Kabul to Pushkalavati, Swat through Buner and Taxila through Hund on the bank of Indus River. The town was once a thriving Buddhisy city surrounded by monasteries and stupas. (Khan *et al*., 2014).

III. Materials and Methods

The phytosociological expeditions were carried out in 2013 -2014. Quadrat method was used to study and analyse the vegetation dynamic as well as to collect the primary data for statistical analyses (Figure 1). A total of 9 sites were laid in the study area. 10 Quadrats were laid in each selected sites having best representation of floral biodiversity and geographic extent of the area.

IV. Vegetation Attributes

Vegetation attributes including frequency, density and cover were recorded. The importance value of each species was compiled adding relative density (RD), relative frequency (RF) and relative cover (RC) following Hussain (1989).

V. Community Named

On the basis of the highest importance values of the first three dominant species from each layer, the communities were established and named. Plants from the premises of sampling points as well as isolated vegetation patches were also collected to record maximum number of species and their distribution patterns. Collected samples were pressed, dried and transported to herbarium of Federal Government College Mardan, Khyber Pakhtunkhawa, Pakistan, where they were identified and classified following Stewart (1961) and Nasir and Ali (1970-94).

VI. Data Analysis

All the communities and species data as well as the field area, were used for the analysis. The PC- ORD ver. 4.16 (McCune & Mefford, 1999) i.e. HCA and DCA, were used for classification and ordination analysis.

VII. Results

In investigated area collectively 48 plant species consisting of 7 shrubs and 41 herbs constructing *Cenchrus-Zizyphus-Saccharum* (CZS) community from 9 sites in which 9 communities i.e. *Fumaria-Rumex-Xanthium* (FRX) community, *Cynodon-Solanum-Sonchus* (CSS) community, *Cynodon-Sorghum-Alhagi* (CSA) community, *Ajuga- Malvastrum-Calotropis* (AMC) community, *Cynodon –Convolvulus-Cyperus* (CCC) community, *Ajuga-Saccharum-Chenopodium* (ASC) community, *Alhagi-Rumex-Euphorbia* (ARE) community, *Saccharum-Cannabis-Xanthium* (SCX) community and *Achyranthus-Ajuga-Euphorbia* (AAE) community were found.

VIII. Hierarchical Cluster Analysis (HCA)

For ordination and classification, important values of floristic data and communities were analyzed by cluster analysis techniques. For agglomerative clustering data were analyzed using different similarity indices, quantitative and work on abundance data. Three similarity indices such as Jaccard's index (JI), Sørensen's index (SI), Correlation' index (CI) on basis of ward's methods were used for agglomerative clustering. Classification by cluster analysis was stopped at the characteristic level so that the size of stands would express ecological significance through their plant life structure on basis of species IV in community. The result of classification was presented in tree like structure i.e. dendrogram, together with the indicator species used by the software for every level of division. The following groups were originated.

a) Faction A

This association is formed at cluster cycle 44 and combined group 4 into group 1 at level 1.8148E+04. This association is formed with the combination of 2 sub group i.e. A1 and A2.

i. *Faction A1*

This association is formed at cluster cycle 42 and combined group 19 into group 1 at level 1.4735E+04. This association is again divided into 2 sub group i.e. A1a and A1b.

a. Faction A1a

This association is formed at cluster cycle 37 and combined group 7 into group 1 at level 1.0032E+04. In this association total 6 species i.e. *Achyranthus aspera*, *Calotropis procera*, *Centaurea calcitrapa*, *Launea procumbens*, *Solanum surattense* and *Sonchus asper* were present. The species present in this faction comprises 53.9 important values (Figure 2; Table 1).

b. Faction A1b

This association is formed at cluster cycle 23 and combined group 21 into group 19 at level 3.4117E+03. In this association total 2 species i.e. *Cynodon dactylon* and *Cyperus scarlosus* were present and total important value was 27.4 (Figure 2;Table 1).

ii. *Faction A2*

This association is formed at cluster cycle 30 and combined group 24 into group 4 at level 6.0752E+03. In this association total 3 species i.e. *Alhagi maurorum, Euphorbia hirta* and *Saccharum spontaneum* were present. The total important value comprises by a fraction was 37.6 (Figure 2; Table 1).

b) Faction B

This association is formed at cluster cycle 46 and combined group 8 into group 2 at level 2.5270E+04. This association is formed with the combination of 2 sub group i.e. B1 and B2.

i. *Faction B1*

This association is formed at cluster cycle 45 and combined group 3 into group 2 at level 2.1210E+04. This association is formed with the combination of 2 sub group i.e. B1a and B1b (Figure 2).

a. *Faction B1a*

This association is formed at cluster cycle 41 and combined group 6 into group 2 at level 1.3319E+04. In this association total 9 species i.e. *Ajuga bractiosa, Boerhaavia procumbens, Cenchrus ciliaris*, *Chenopodium album, Malva neglecta, Solanum nigrum, Sonchus arvensis, Stellaria media* and *Tribulus terrestris* were present. The total important value of fraction was comprises 43 (Figure 2).

b. *Faction B1b*

This association is formed at cluster cycle 43 and combined group 17 into group 3 at level 1.6337E+04. This association is formed with the combination of 2 sub group i.e. B1bi and B1bii (Figure 2).

- *Faction B1bi*

This association is formed at cluster cycle 40 and combined group 5 into group 3 at level 1.2386E+04. In this association total 13 species i.e. *Ajuga parviflora, Amaranthus viridis, Capsella bursa-pestoris, Cassia occidentalis, Chenopodium murale, Cyperus rotundus, Datura metel, Euphorbia prostrate*, *Gallium aparine, Malvastrum coromandelianum, Parthenium hysterophorus, Riccinis communis* and *Silybum marianum* were present. In this fraction total important value 44.9 was contributed by 13 species (Figure 2; Table 1).

- *Faction B1bii*

This association is formed at cluster cycle 38 and combined group 23 into group 17 at level 1.0771E+04. In this association total 6 species i.e. *Convolvulus arvensis, Euphorbia helioscopia, Oxalis corniculata*, *Sorghum halepense, Taraxacum officinale* and *Withania somnifera* were present. The species in the fraction contain the total important value was 36.7 (Figure 2; Table 1).

ii. *Faction B2*

This association is formed at cluster cycle 39 and combined group 10 into group 8 at level 1.1564E+04. In this association total 9 species i.e. *Cannabis sativa*, *Carthamus oxycantha, Chrozophora oblique, Cymbopogon distans, Fumaria indica, Heliotropium europaeum, Rumex dentatus, Sonchus auriculata* and *Xanthium strumarium* were present. The total important value 56.5 was comprises by this fraction (Figure 2; Table 1).

IX. Detrended Correspondence Analysis (DCA)

Second method used was ordination analysis that employed abundance data using the 'Domin scale' without any transformation. Preliminary analysis using Detrended Correspondence Analysis (DCA) suggested that ordination using DCA provided more robust and interpretable results and in terms of species and communities turnover or standard deviation (s.d). Detrended Correspondence Analysis (DCA) was performed to describe compositional gradients in the vegetation. DCA was performed using a default value for detrending and rescaling. The Detrended Correspondence Analysis showed that the highest weighted mean species scores 2.88% was presented by *Stellaria media* followed by *Boerhaavia procumbens* (2.76%) and *Chenopodium album* (2.75%) while the lowest weighted mean species scores 0.83% was presented by *Withania somnifera* followed by *Calotropis procera* (1.36%) and *Sonchus asper* (1.37%). At AX1 the 7 species values was high than 200. The highest values was found by *Sonchus auriculata* (341) followed by *Carthamus oxycantha (*297), *Fumaria indica (*268), *Rumex dentatus* (262), *Xanthium strumarium* (235), *Heliotropium europaeum* (218) and *Chrozophora oblique* (209). In AX1 the 6 species values was less than 50. The lowest values was presented by *Withania somnifera* which was zero followed by *Gallium aparine* (2), *Malvastrum coromandelianum* (13), *Convolvulus arvensis* (20), *Amaranthus viridis* (32) *and Taraxacum officinale* (36). Between 50 and 200 values the 35 species were present (Figures 2; 3). At AX2 the 5 species was high values above 200. The highest values 290 was found in *Datura metel* followed by *Riccinis communis* (234), *Malvastrum coromandelianum (*214), *Gallium aparine* (203) and *Silybum marianum* 196.

In AX2 the 6 species values was less than 50. The lowest values zero was presented by *Malva neglecta* followed by *Oxalis corniculata* (15), *Withania somnifera* (16), *Tribulus terrestris* (32), *Saccharum spontaneum* (32) and *Solanum nigrum* 46. The 37 species were present between 50 and 200 values (Figures 2; 4). At AX3 the 10 species was high values above 200. The highest values 279 was presented by *Euphorbia prostrate followed by Stellaria media* (271), *Amaranthus viridis* (255), *Sonchus arvensis* (251), *Cenchrus ciliaris* (244), *Capsella bursa-pestoris* (236), *Parthenium hysterophorus* (233), *Cyperus rotundus* (223), *Silybum marianum* (217) and *Chenopodium album* 207. Only single specie i.e. *Sonchus auriculata* have a zero values. The 37 species were present between 50 and 200 values (Figures 3; 4). Among communities the weighted mean communities scores was high 26.7% of FRX while low 2.98% of CSA at Axis 1. At Axis 2 the highest weighted mean community's scores was 32.7 % of AMC and low -7.3% of CSA. 22.9% was the highest weighted mean communities scores presented by SCX and low zero percent in FRX (Figure 6).

X. Discussion

The investigated area comprised of 48 species in the 9 communities. The environmental factors, habitat and different plant life determined communities' structure. Plants communities are useful in classification, naming and identification of vegetation structure. The results showed that vegetation structure is diverse in the area. Muller Dumbois and Ellenberg, (1974) stated that plant community structure interpret and analyze the plant life at diverse revelation. The factors which influenced plant life structure are unplanted settlements, overgrazing, erosion, land sliding, habitat destruction, poverty and anthropogenic activities. During research work it is noticed that grazing rate and erosion is high due to which natural vegetation is diverse. Khan and Hussain, (2012) stated that the animal palatability effect the vegetation structure. Khan *et al.,* (2014) stated that the investigated area was under heavy biotic pressure due to deforestation and over grazing. Brinkmann *et al*., (2009) evaluated the vegetation reaction to ecological

situation of open woodlands along an altitudinal and animal palatability preference. Soil is essential that has continued life on earth and it also helps the plants' growth that increased the competition of grazing animals and human. The soil of research area is clay. Vegetation changed the physical and chemical properties of soil. It improves the soil infiltrations, structure and prevents erosion. Shameem *et al*., (2011) and Buckman and Brady, (1967) described that the resources of soil is limited and its physical and chemical properties are restricted mostly by humus and clay. It is noticed that with the passage of time human transportation and population are increase in research area which effect the vegetation structure. According to Turner *et al*., (2004) and Shameem *et al*., (2011) stated that the distinctive habitation altered due to increasing human transportation and population. Several research works dealing with different features of plant life from diverse parts of the state have been taken out from time to time (Stewart, 1982; Dar *et al*., 2001). The investigated area presents a limited number of animal and plant species. The investigated area is more suitable for the legume plant due the presence of high content of sand particles in the area. Plant growth somewhat indirectly manipulated through soil structure. It also effects the seedling growth which is very sensitive to physical condition of soil texture. The rigid compacted layer slows down the growth of the seedling for root cannot penetrate easily in such soil.

XI. Conclusion

This study pointed out that climatic environment of area has restricted mobilization of area and association of plant was changed with the change of environment and population. Plant ecologists have commonly been aware that vegetation shows an inconsistency over a broad variety of particular scales and area. Therefore, it is needed that we apply the multivariate techniques i.e. HEC and DCA methods for studying the degree of vegetation differences.

XII. Acknowledgements

Authors are grateful to the local people of area who have revealed the precious information about plant species and assistance. We cannot forget all our friends for all support they accorded us during the period we carried out this study.

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Figure 1 : Taking a Quadrat for shrubs vegetation study in research area

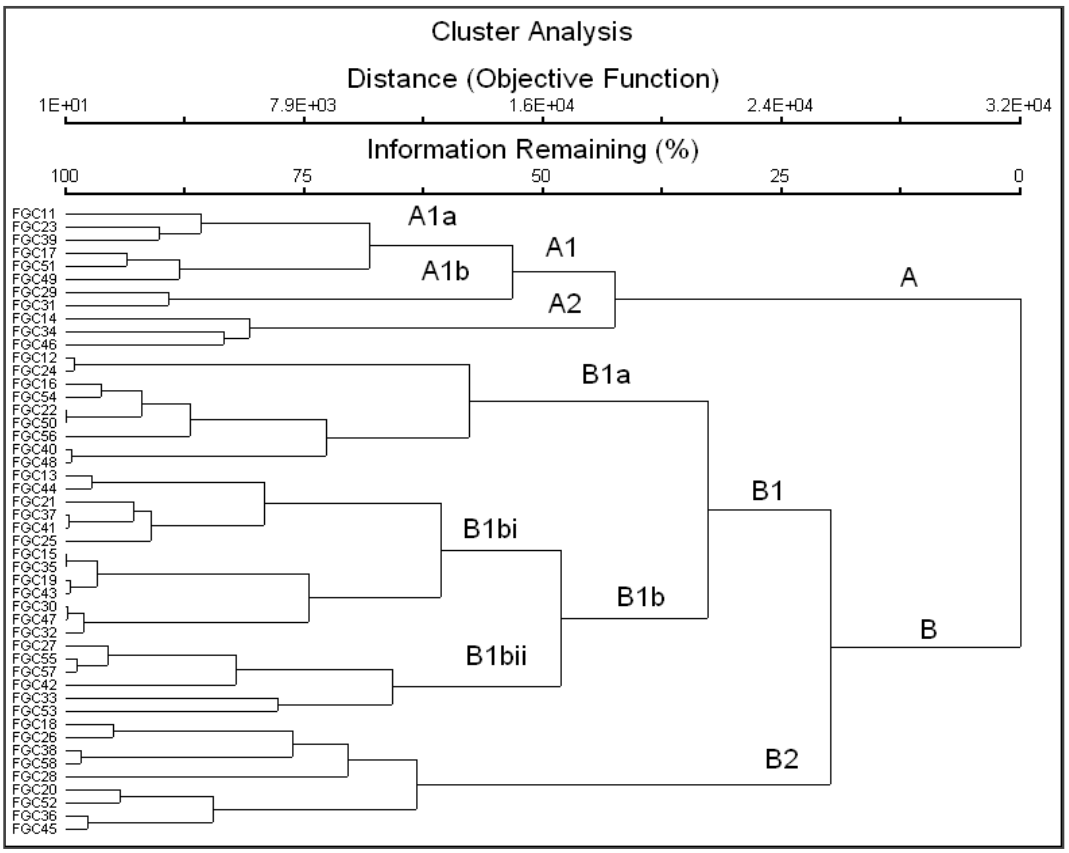

Figure 2 : Two way cluster dendrogram showing grouping of different plant species into association of Shahbaz Gari, District Mardan

Table 1 : Mean relative importance value of plant species in different associations distinguished through cluster analysis of Shahbaz Gari, District Mardan

Group	Sub group		Species	VN	FRX	CSS	CSA	AMC	CCC	ASC	ARE	SCX	AAE	IV	TIV
A	A1	A1a	*Achyranthus aspera* L.	FGC211	-	19.6	17	13.8	11.1	-		12	25	10.9	53.9
			Calotropis procera (Wight.) Ali.	FGC217	-	23.5	16.9	17.8	13.8	-	10.6			9.17	
			Centaurea calcitrapa L.	FGC223	-	20	-	-	14.7	-		6.9	13.7	6.14	
			Launea procumbens Roxb.	FGC239	-	24.2	-	16.5	17.4	-	15.8	13.7	13.1	11.2	
			Solanum surattense Burm.f.	FGC249	-	26.4	15.3	6.43	-	-	18		13	8.79	
			Sonchus asper (L.) Hill.	FGC251	-	26.3	19.2	13.1	-	-		10		7.63	
		A1b	*Cynodon dactylon* L. Pers.	FGC229	21.2	32.5	26.9	-	26	-	14.4		13	14.9	27.4
			Cyperus scarlosus R.Br.	FGC231	18	22.2	18.7	-	20.8	-	17.8	15.2		12.5	
	A2		*Alhagi maurorum* Medic.	FGC214	16.6	22	24.2	12		20.1	25	11.9	10.1	15.8	37.6
			Euphorbia hirta L.	FGC234		22.1		6.62		20.7	21.4	9.7	17.4	10.9	
			Saccharum spontaneum L.	FGC246		22.1	15.5			25.1	15.5	20.6		11	
B	B1	B1a	*Ajuga bractiosa* Wall. Benth.	FGC212				20.7		26.1			24.1	7.87	43
			Boerhaavia procumbens Banks ex Roxb.	FGC216				12.7		15.1				3.08	
			Cenchrus ciliaris L.	FGC222						18.8	13.4	7.46		4.41	
			Chenopodium album L.	FGC224				13.1		22.6			13.9	5.51	
			Malva neglecta Wallr.	FGC240			17.3			18.3				3.96	
			Solanum nigrum L.	FGC248			17.8			16.1			11.8	5.08	
			Sonchus arvensis L.	FGC250						20.1	14.3	11.7		5.11	
			Stellaria media (L.) Cry.	FGC254						19.8		9.4	7	4.02	
			Tribulus terrestris L.	FGC256		18.3				17				3.92	
		B1bi	*Ajuga parviflora* Benth	FGC213				15.3	13.7		9.5		14.7	5.91	44.9
			Amaranthus viridis L.	FGC215					12.2			11.5		2.63	
			Capsella bursa-pestoris Medic.	FGC219					12.9			15.2	16.5	4.95	
			Cassia occidentalis L.	FGC221	16.3			16.9	16		9.5			6.53	
			Chenopodium murale L.	FGC225					12.3		13.1			2.82	
			Cyperus rotundus L.	FGC230				13.5				14.1		3.07	
			Datura metel L.	FGC232				7.41						0.82	
			Euphorbia prostrata L.	FGC235					8.82			16.3		2.79	
			Gallium aparine L.	FGC237				10.9	15					2.88	
			Malvastrum coromandelianum(L.) Garcke.	FGC241				18.2	18.4					4.06	
			Parthenium hysterophorus L.	FGC243					11			9.1	8.1	3.13	
			Riccinis communis L.	FGC244				12.1					16.9	3.22	
			Silybum marianum (L.) Gaertn.	FGC247				9.88				9.2		2.12	
		B1bii	*Convolvulus arvensis* L.	FGC227			20.6		23.4			13.5		6.39	36.7
			Euphorbia helioscopia Mewski.	FGC233	17.7		14.9		9.65				21.1	7.05	
			Oxalis corniculata L.	FGC242			17.2				15.6	12.4		5.02	
			Sorghum halepense (L.) Persoon.	FGC253			25.9	11.2	20		16.8		16.9	10.1	
			Taraxacum officinale Weber.	FGC255			17.5	10.7	12.8			6.97		5.33	
			Withania somnifera (L) Dunal.	FGC257			15.2		10.1					2.81	
	B2		*Cannabis sativa* L.	FGC218	16.9			16.9		12.4	16.7	18.6	10.7	10.3	56.5

		Carthamus oxycantha M. Bieb.	FGC220	24.6					20.1				4.97	
		Chrozophora oblique (Vahl) A. Juss.	FGC226	21.7			8.86			15.4	12.6		6.51	
		Cymbopogon distans (Nees ex Steud.)Watson.	FGC228	22.8	20.8		15.4					9.5	7.61	
		Fumaria indica (Hausskn) Pugsley.	FGC236	28.1					15.4	15.6			6.57	
		Heliotropium europaeum L.	FGC238	20.7							15.2	13	5.43	
		Rumex dentatus L.	FGC245	27.6						21.6			5.46	
		Sonchus auriculata L.	FGC252	20.9									2.32	
		Xanthium strumarium L.	FGC258	26.9					12.4		16.7	10.5	7.4	

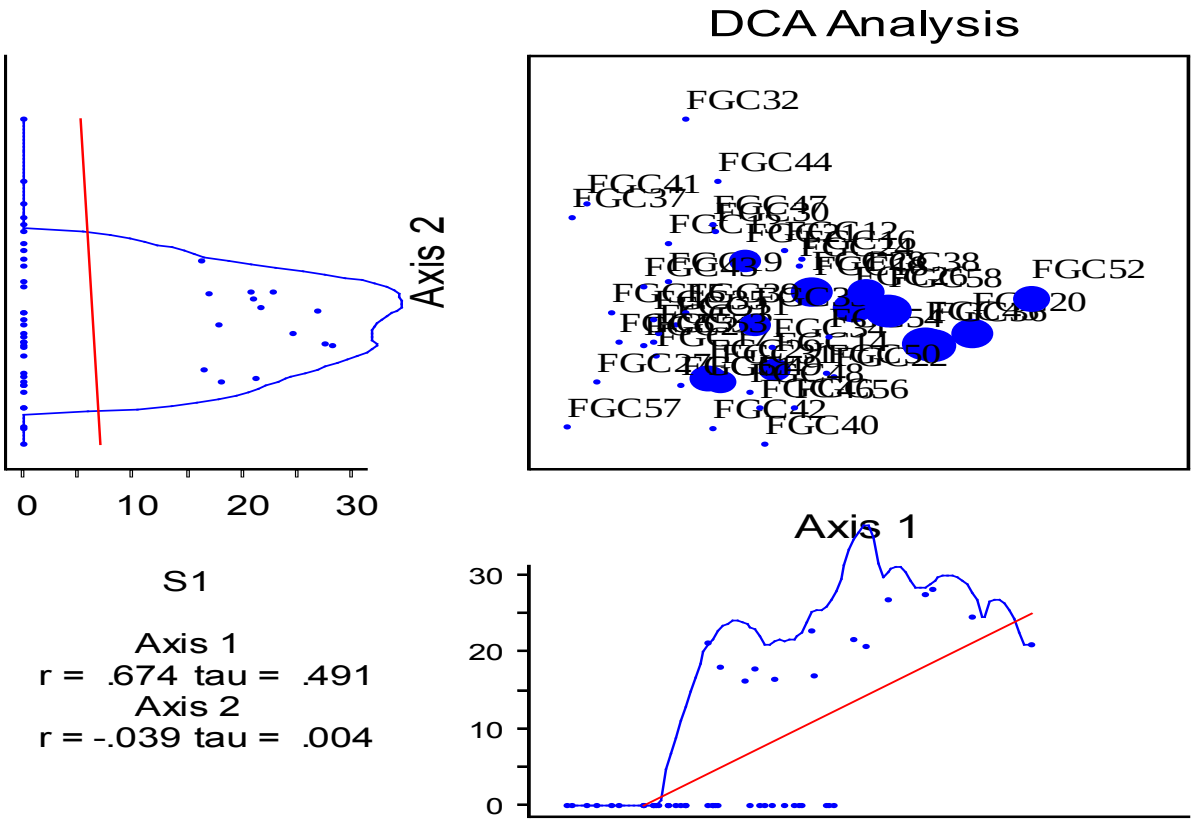

Figure 3 : Sample scores at Axis 1 and Axis 2, which show weighted mean species scores

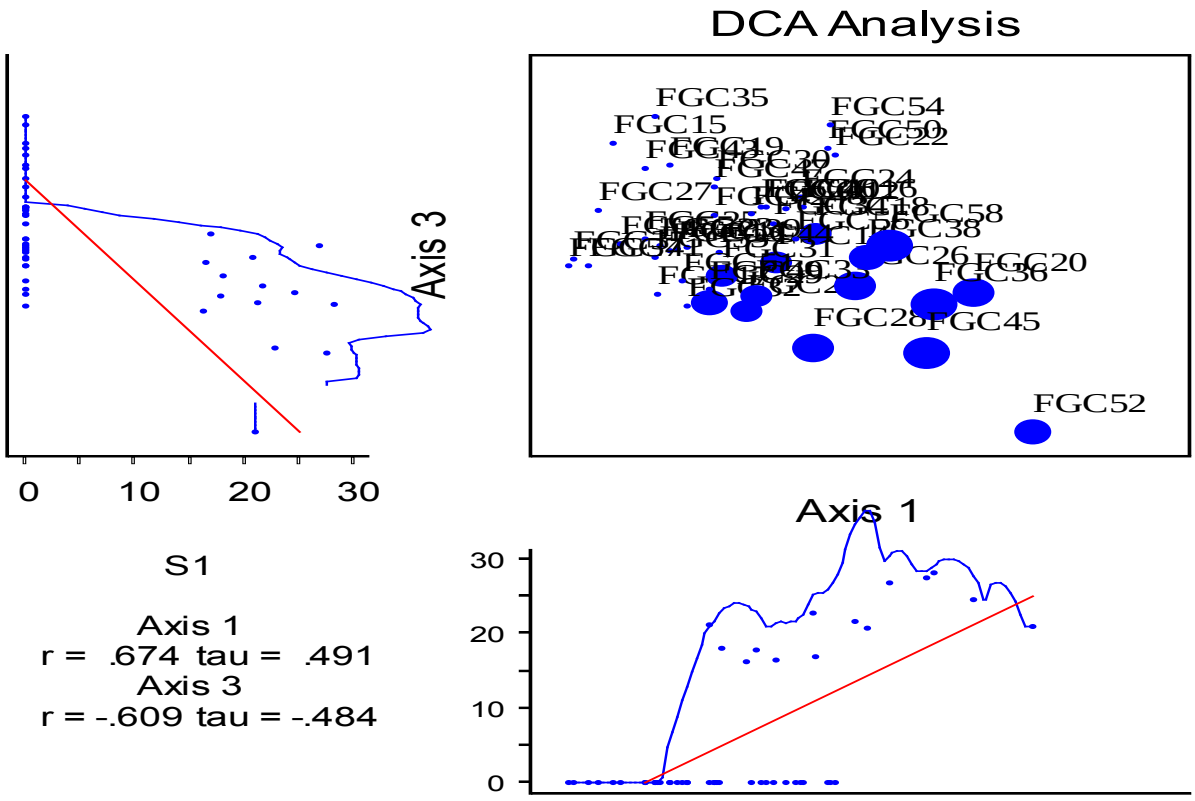

Figure 4 : Sample scores at Axis 1 and Axis 3, which show weighted mean plant species scores.

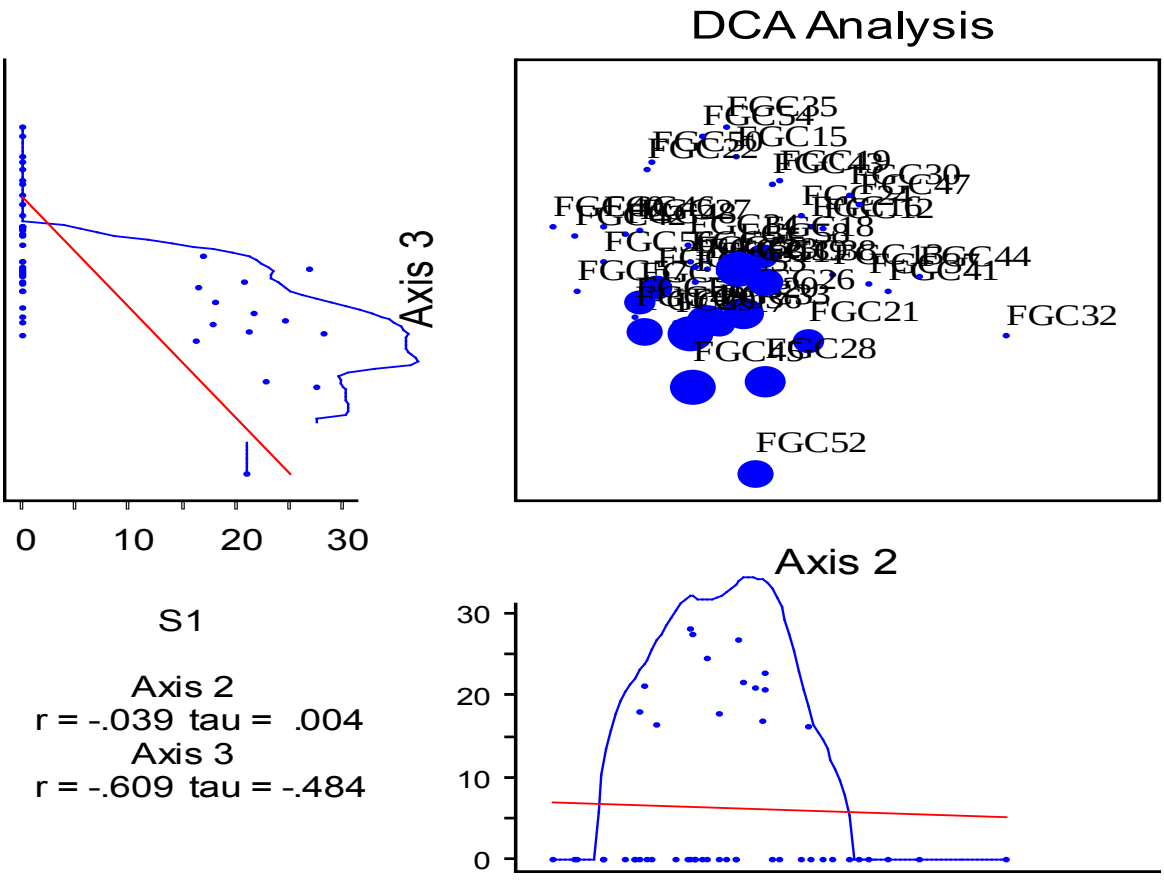

Figure 5 : Sample scores at Axis 2 and Axis 3, which show weighted mean plant species scores

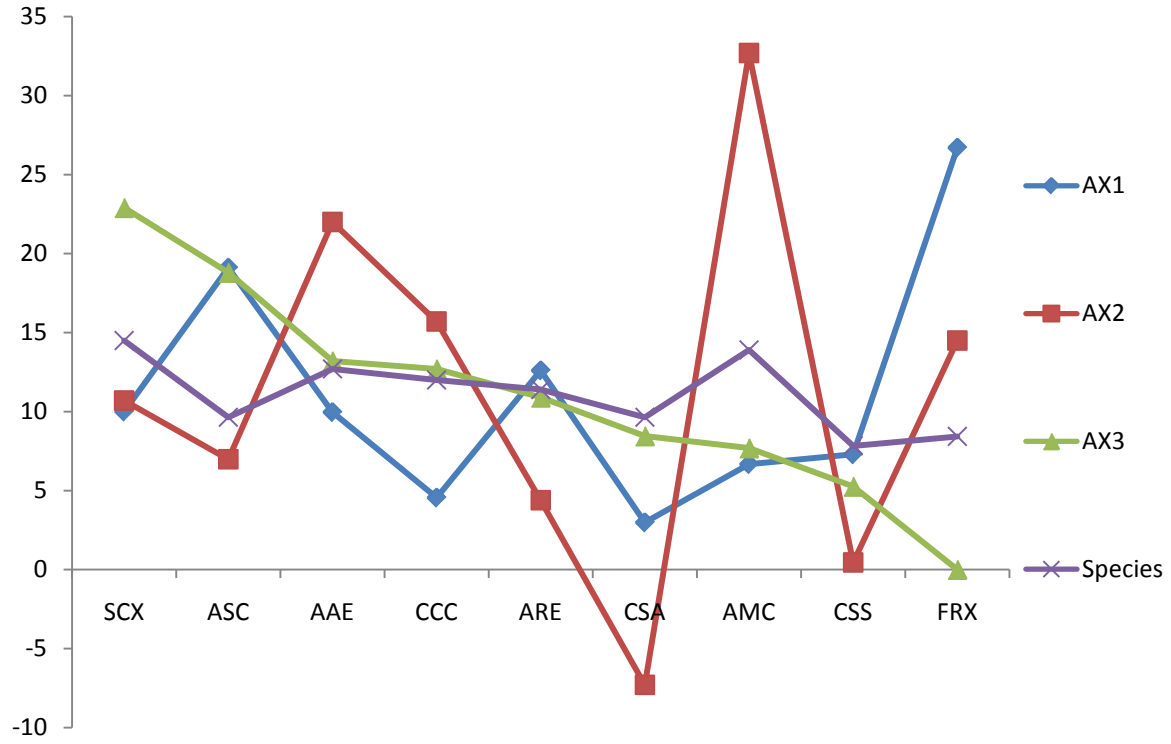

Figure 6 : Communities scores at Axis 1, Axis 2 and Axis 3, which showed weighted mean communities scores.

Figure 7 : Group photo during research study

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