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Scaling of Multivariate Ground Flora Data of Gatwala Forest Park (GFP), Faisalabad Pakistan

[1]*Sheikh Saeed Ahmad,* [2]*Mohammad Nawaz,* [2]*Abdul Wahid,* [1]*Benish Malik and* [1]*Rabail Urooj*

[1]Department of Environmental Sciences, Fatima Jinnah Women University, Rawalpindi, Pakistan
[2]Department of Environmental Sciences, Bahauddin Zakariya University, Multan, Pakistan

Abstract: In the study area, vegetation was classified and ordinated by multivariate techniques. Randomly, floristic data was collected through quadrat method (quadrat size: 1m x 1m) from the self designated two zones of the GFP. Deterended Correspondence Analysis (DCA) was applied in order to ordinate the plant communities. The species abundance was compared with the dominance curve in order to show the validity of the delineated results of DCA. The results of DCA and dominance curve revealed that *Cynodon dactylon* and *Dichantium annulatum* were best fit to the prevailed environmental factors, while certain species were found to be scarce at study site i.e. *Galium aparine* and *Avena sativa* in Zone-I and Zone-II respectively. The grouping of the existing species was showing their common interests as life form and habitat. It was predicted that present situation of vegetation composition will sustain in further provided no drastic environmental change or highly competitive exotic plant species intrude in the study area.

Key words: Classification · Multivariate techniques · Ground flora · Gatwala Forest Park · Pakistan

INTRODUCTION

In attempts to organize species and samples according to the site characteristics, ecologists have accepted, adapted and adopted the multivariate techniques [1]. Plant communities are composed of many species and these communities' structures include the intermingling factors for their distribution. Today versatile multivariate techniques are available to study the complex nature of the plant communities. These techniques are applied to investigate the qualitative data upon abundance, presence, absence of either the species or on samples and combined analysis is also done [2]. For classification, the species/ samples (members) are arranged in groups, sharing common characteristics while in ordination, the species/samples are arranged along the axis with defined position and distance according to their properties[3].

Detrended Correspondence Analysis (DCA), developed by Hill and Gauch [4] is modified indirect analysis ordination technique, used in order to explore the interrelationship of species and their environmental parameters [5] as it does not require environmental data during analysis and evaluate the species distribution and composition [6]. A total of 172 sampling plots were assessed at study area. From 172 Samples, 9 groups were aggregated by detrended correspondence analysis (DCA) along the altitude as a gradient. This study provided evidence that hydrologic gradients and biotic factors commonly determine the spatial pattern of wetland plant communities [7]. A survey of motorway (M-2), Pakistan, roadside vegetation and soils was undertaken by Ahmad *et al*. (2010) using Braun-Blanquet's approach, floristic data was collected and analyzed by DCA[8]. Two major and 16 sub-communities were recognized along motorway. Usually changes in densities, frequencies and abundances of targeted plants with a slight ecological tolerance are frequently used as indicators for local ecological change or habitat quality [9].

Relationships among species and environment should clearly be understood by the ecologist in habitats [10]. Resultantly, microhabitat was the main factor which influenced the compositional patterns of the herbaceous species over the study site [11].

Corresponding Author: Sheikh Saeed Ahmad, Department of Environmental Sciences, Fatima Jinnah Women University, Rawalpindi, Pakistan. Cell: +92-0321-5167726

MATERIALS AND METHODS

The Faisalabad District lies from 30° 42' to 31° 47' North latitude and 72° 40' to 73° 40' East longitude and altitude of 184.4 m. Usually, in summers high temperature remains prevalent. Growth of the plants greatly reduced down if the temperature exceeds from optimum range mostly ranging from 50 to 52 °C in summers and of 5 to (-1) °C in winters. The average annual rainfall is about 200 mm. Gatwala forest park (GFP) is situated along 17 Km Faisalabad-Sheikhupura road, 12 km from Khurianwala, Pakistan. This park is a Game Reserve under Wildlife Act, Government of Pakistan, 1997 which was established in 1992 as Gatwala Wildlife Park and Breeding Center. Total covered area is about 53 hectors with geographical location of 31°-50' N, 73°-90'E.

For the sake of feasibility in data collection, total study area was divided up to two Zones. The Zone I and Zone II. Braun-Blanquet approach of floristic characteristics, which is also known as 'Zürich-Montpellier School' of phytosociology was used [2,13]. This approach focuses on recording the data of species on the basis of cover estimation and vegetation type. Randomly floristic data was recorded with $1m^2$ quadrat size by visual estimation of cover percentage as generated by Kent & Coker[3]. Composite soil samples were also collected, tested and recorded. Soil moisture EC, organic matter and pH were analyzed in order to show the relationship among species and gradients through CCA [14,15]. For DCA application a total of 172 sampling plots were assessed at study area which aws divided into two zones zone –I and zone - II. From 172 Samples, 9 groups were aggregated by Deterended correspondence analysis (DCA) along the altitude as a gradient.

RESULTS

DCA was used to analyse the indirect ordinations. The distances between the points on the graph are taken as a measure of their degree of similarity or difference. The analysis has ordinated the plant communities in both of the zones. The grouping and associations of the existing species was projecting light towards their common interests of life form and habitat. DCA results were compared with dominance curve between Logsum and Rankabundance in order to show the validity of analysis. In both of analysis codes had been given to all species e.g code *Cynodon dactylon* is cyn-dac. Overall 5 communities with 3 outliers were delineated by DCA analysis. The names are given to the communities on the basis abundance.

***Cynodon dactylon, Oxalis corniculata, Malvastrum coromendelianum* community:** This community has highest number of abundant species from the rank-1(green dots) species of dominance curve i.e. *Cynodon dactylon, Oxalis corniculata* and *Malvastrum coromendelianum community* with percentage cover of 47%, 21%, 21.5% respectively. Similarly, this is the only community in Z-I which has aggregated 13 species belonging to all of the ranks.

***Dichanthium annulatum, Stellaria media, Coronopus didymus* community:** The percentage cover values of these abundant members are 44%, 21.5 % and 17%. Further associated species are from lower ranks. In this community 11 species are present in this community.

***Panicum antidotale, Ranunculus muricatus, Phalaris minor* community:** Only 4 species are present, belonging to first 4 ranks. The percentage cover values of the dominating species are 25%, 15% and 13.5%. An outlier to this community is *Kochia indica,* due to different characters this specie did not participate in the formation of this community.

***Cenchrus ciliaris , Cirsium arvense, Ageratum conyzoid* community:** These three species with the percentage cover value 4%, 3% and 1.5% respectively, are only participants for this very community.

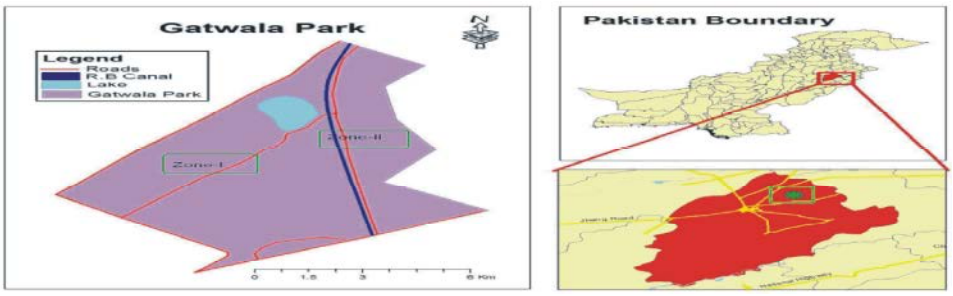

Fig. 1: Map of study area

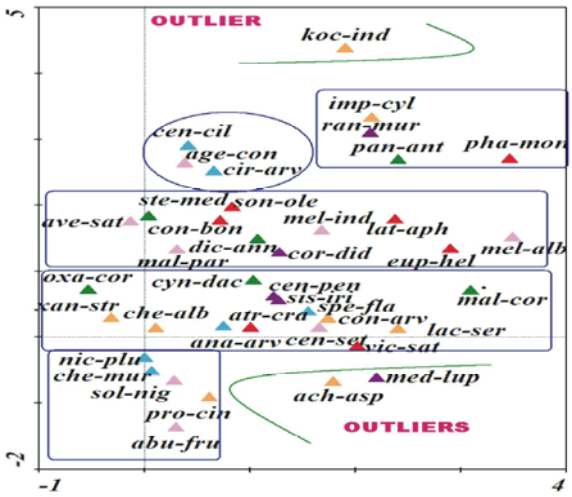

Fig. 2: DCA analysis lay out for Z-I of GFP, with demarcated communities and labeled outliers

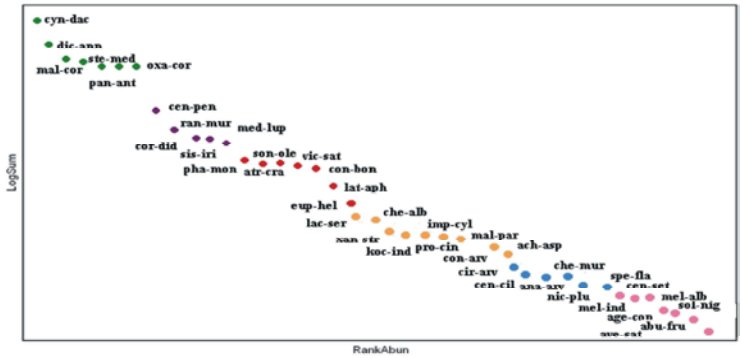

Fig. 3: Dominance curve between logsum and rankabundance of species in Z I

***Chenopodium murale, Nicotiana plumbaginifolia, Prosopis cineria* community:** Species were grouped in this community. The percentage cover of *Chenopodium murale, Nicotiana plumbaginifolia* and *Prosopis cineria* are 2.5% and 2%, 2% of. The Outliers to this community are *Achyranthus aspera* and *Medicago lupulina.* Dominance curve between logsum and rankabundance of species in Z I is shown in figure 3.

These ranks were given on the basis of abundance with respect to percentage cover values

- Green dots are showing Rank-I species with the average percentage cover range between 47-21%.
- Purple dots are showing Rank-II species with the average percentage cover range between 21-15.5%.
- Red dots are showing Rank-III species with average percentage cover range between 15%-8.5%.
- Orange dots are showing Rank IV species with average percentage cover range between 10-5.5%.
- Blue dots are showing Rank V species with average percentage cover range between 3-2.5%.
- Pink dots are showing Rank VI species with average percentage cover range between 2-1%.

DCA analysis lay out for Z-II of GFP, with demarcated communities and labeled outliers is shown in figure 4.

A total of 5 communities with 3 outliers were present.

***Dicanthium annulatum, Cynodon dactylon, , Cenchrus pennisetiformis* community:** This is the largest community with 4 species out of 17, from rank-I. The percentage cover values of these dominating species are 38%, 33.5% and 24.5% respectively. *Galium aparine* and *Kochia indica* are the outliers.

***Oxalis corniculata, Medicago lupulina, Coronopus didymus* community:** The cover values in percentage for these 3 abundant species of this community are 24.5%, 19.5% and 15.5% respectively. Total 6 species are present in this community.

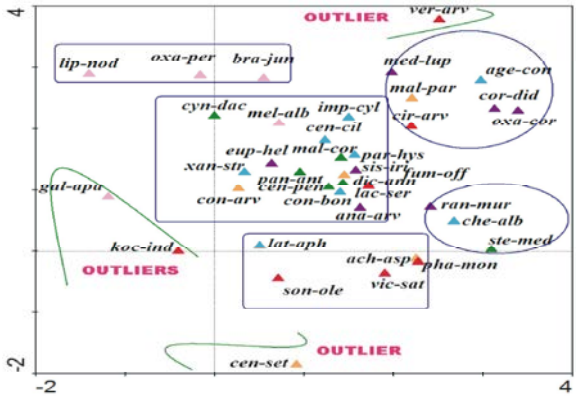

Fig. 4: DCA analysis lay out for Z-II of GFP, with demarcated communities and labeled outliers

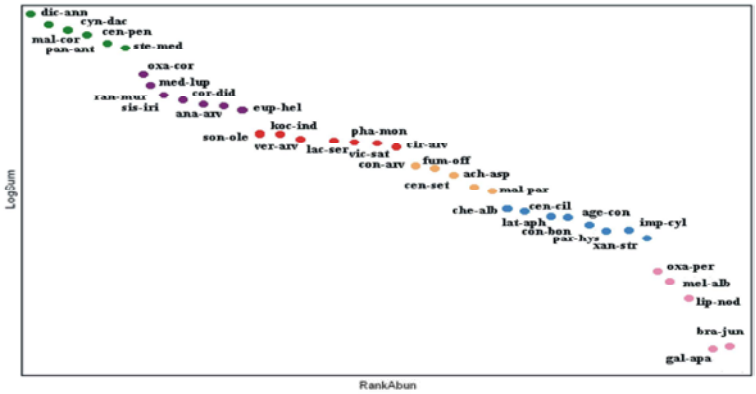

Fig. 5: Dominance curve between logsum and rankabundance of species in Z II

***Stellaria media, Ranunculus muricatus,Chenopodium album* community:** This community has only these three members with the percentage cover values of 21%, 18%.

***Sonchus oleoraceus, Phalaris minor, Vicia sativa* community:** 16%, 11.5% and 12% are the percentage cover values of these species. In this community total 5 species are present belonging to different ranks. *Kochia indica* is outlier.

***Oxalis perpurea, Lippia nodiflora*, *Brassica juncea* community:** This is the smallest community. All of these species were scarce in the park with cover percentages 1.5%, 1% and 0.5% respectively. Dominance curve between logsum and rankabundance of species in Z II is shown in figure 5.

These ranks were given on the basis of abundance with respect to percentage cover values

- Green dots are showing Rank-I species with average percentage cover range between 47-21%.
- Purple dot are showing Rank-II species with average percentage cover range between 19.5-16%.
- Red dots are showing Rank-III species with average percentage cover range between
- 16-10%.
- Orange dots are showing Rank-IV species with average percentage cover range between 7-5.5%.
- Blue dots for Rank-V species with average percentage cover range between 4-2%.
- Pink dots are showing Rank-VI species with average percentage cover range between 1.5-0.5%.

DISCUSSION

Multivariate techniques proved to be best techniques for ecologists in classifying the vegetation environment data. In the study area ,ten abundant herbaceous plants were *Cynodon dactylon* and *Dicanthium annulatum* followed by *Cenchrus pennisetiformis, Panicum antidotale, Stellaria media, Ranunculus muricatus, Medicago lupulina*, *Oxalis corniculata, Sisymbrium irio* and *Coronopus didymus. Cynodon dactylon* and *Dichanthium annulatum* shared dominance in GFP. Zahran and Willis (2009) *by* DCA found association of *Cynodon dactylon* and co-dominant specie *Dichanthium*

annulatum with many other species within a single community as well as with the species of other community [16]. Ahmad *et al*., 2010 by DCA suggested that there were no significant variations in abundance between the species to sample composition in both zones [17,18]. This indicated that similar climatic, natural and anthropogenic factors were involved in constructing species composition in both zones[8].

Resultantly, the dominance curve found that study area was being dominated by grasses as compared to other herbs. It is highly recommended that effective management program should be introduced at study area to conserve viable species.

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