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An Appraisal of Ecological Distribution of Herbaceous Flora at Gatwala Forest Park Faisalabad, Pakistan

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Abstract: The classification of herbaceous vegetation into groups establishes the link between researcher and resource managers, because the natural ground flora of any region represents the soil conditions, climate trends and indirectly refers to the overall natural system. Classification is an eminent mean that provides a description of vegetation units within a particular region and it values to natural ground flora. It also helps us to determine the similar response exhibited by various species on the ecosystem. The study has been conducted at the Gatwala Forest Park, a protected/game reserve area located in the heart of Pakistan's third largest city Faisalabad, in the province of Punjab. This park spans over an area of 53 hectors. Floristic data was randomly collected at the site for ground flora. The survey resulted in identification of 46 species belonging to various plant families. The major causative factor impeding this ground flora's growth was the presence of planted exotic species (as they take away the major chunk of nutrients and sunlight, or shed their leaves to cover the ground) and direct or indirect human activities. TWINSPAN technique was used to classify the data collected. Dominant species observed there were *Cynodon dactylon, Dichanthium annulatum, Cenchrus pennisetiformis, Panicum antidotale, Malvastrum coromandelianum, Oxalis corniculata, Stellaria media, Ranunculus muricatus, Sisymbrium irio* and *Medicago lupulina.* Four Major groups are delineated using the ordination analysis. The study identifies and highlights the critical need for the protection and conservation of flora in Gatwala game reserve.

Key words: Plants Classification · Grouping · TWINSPAN · Gatwala forest park · Faisalabad

INTRODUCTION

For the long term management of natural resources the natural ecosystem of the particular area should be classified into prospective plant communities. This has been become an easier but a bit technical task for an ecologist to determine the composition of the respective data by using multivariate classification techniques [1, 2]. Various ecological processes are taking their part in constructing plant community structure. Forest compositions, community structure and diversity patterns are the most significant ecological characters which are interrelated with existing environment as well as anthropogenic alteration [3, 4, 5]. The similarity of community species composition can be an indicator to the heterogeneity in community habitats [6]. It has been mentioned in various studies that difference in community structure is interconnected to the variability in geography, human community interface and the competition among plants [7, 8, 9]. From the point of view of competition, indigenous plants are more resistant to infections in contrast to the aliens [10] but the exotic species are fast growing than indigenous species [11]. Due to the introduction of exotic species the ground flora's growth gets stunted due to their less access to the nutrients and habitat loss. Habitat loss is the main threat to biodiversity [12]. The greater part of biodiversity problem concerning is the relationship between biodiversity and ecological services from which human beings reap certain benefits [13].

The natural environment is paying the penalty of advancement, pollution and exotic species [14]. Hence, there is an imperative need for biological assessment and there is also a need to classify the vegetation in order to conserve it which will be beneficial in future [15, 16]. For this reason TWINSPAN (Two Way

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Indicator Species Analysis), an easily interpretable multivariate technique for the classification of the species was used [17]. TWINSPAN was formulated by Hill as a fortran program for the classification of species and samples into two-way cluster table or dendrogram [18]. The relationship among species and samples is shown with TWINSPAN analysis as it ordinate the samples and then to species accordingly. Those sample plots which have most of the species in common are clustered closer to each other than the samples which have large differences in species composition. The TWINSPAN technique utilizes a centroid line to follow the pattern of division of main entities. It divides them into two groups then into four, eight and so on. As TWINSPAN is an indicator analysis, so it identifies an indicator species which indicates the vegetation communities on the basis of its dominance or weakness with respect to abundance [19].

Many examples are found in literature which shows the importance of TWINSPAN. Ahmad et al., surveyed the motorway (M-2) roadside vegetation. In this study, Braun-Blanquet's approach was used for data collection and TWINSPAN was used for the purpose of classification of the floristic data, taken from 397 quadrats. The study has found the two major and 16 sub-communities. Two hundred and twenty seven vascular plants species were also recorded along 358 km along the motorway. Basically the study has provided the key information for the improvement of the road margins of M-2 [5]. Ahmad and Quratulann conducted a survey in Ayubia National Park which is also a protected/National Park. Their study classified the different species abundance along with the distribution. They observed 59 species belonging to 32 families. Overall two major communities were identified by using TWINSPAN [20]. The Two Way Cluster Analysis and Indicator Species Analysis ISA were used by Khan for the classification of vascular flora. TWINSPAN is one of the best clustering techniques [21]. Similarly, a research was conducted in order to apprise the vegetation communities of the Islamabad city's green belts, gardens and parks. The recorded plant species were 162, the data was then subjected to TWINSPAN, with some overlapping because of the four major communities were found. This overlapping in ordination was because of the homogeneity in the nature of vegetation type [22]. TWINSPAN was applied for classification of vegetation in Highveld National Park (HNP), South Africa with the purpose of to conserving Rocky Highveld Grassland and Dry Sandy Highveld Grassland in HNP area. Floristic and soil degradation data were collected from the twenty plots by following Braun-Blanquet technique. Overall three major and three minor communities were identified by Daemane [23].

The purpose of the present appraisal was to highlight the significance of herbaceous flora of the study area by employing ordination classification technique. The results will aid in developing better management practices and for future surveys will be aimed with the conservation of this valuable creation of the nature in Gatwala forest park.

MATERIAL AND METHODS

Faisalabad is an arid region. The climate of the city is considered to be of extreme nature, with temperatures ranging from 38 to 45°C in summer and of 17-6°C in winter. The average annual rainfall is about 200 mm [24]. Present study was conducted in Gatwala forest park (GFP) situated in 17 Km Faisalabad-Sheikhupura road, Pakistan. This is an artificial forest and has been given the status of Game Reserve under Wildlife Act, Government of Pakistan, 1997 [25]. This Artificial Raised Forest/Breeding centre/Game reserve was established in 1992 as Gatwala Wildlife Park and Breeding Center. (GFP) covers an area of 131 Acres (53 ha). The geographical location of the park is 31°-50' N, 73°-90'E.

The total area of park was divided into two zones. Zone-1(Z-I) was adjacent to the Rakh Branch Canal that is passing across the right side of forest park. The water of this canal is used for the irrigation. Zone-2(Z-II) was present far from the canal and on the left side of the entrance gate but the same water is used for watering. Human encroachment, grazing and cutting were almost equal in both of the zones. Random sampling technique was under taken for the collection of floristic data by following Braun-Blanquet approach. Hundred quadrats of 1m x 1m were laid down in each zone. The percentage cover was recorded by the "DOMIN" scale [19]. Classification of the community based on the floristic composition was done by TWINSPAN (Two Way Indicator Species Analysis) by using the software PC-Ord 5.

RESULT AND DISCUSSION

Classification was done for the overall vegetation of area in order to give value to the plant communities and heterogeneity of the community. In the present study,

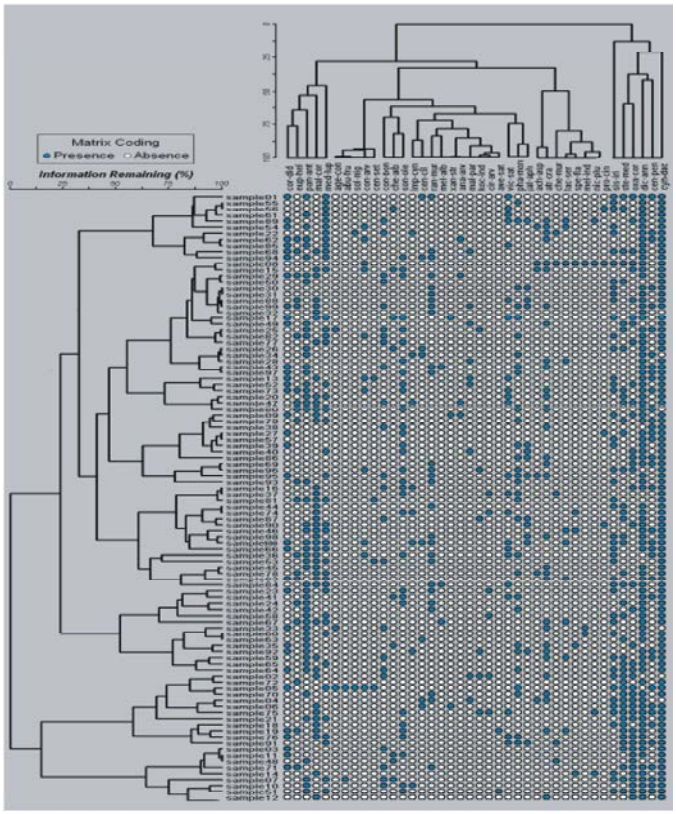

Fig. 1: TWINSPAN classification in Zone-I

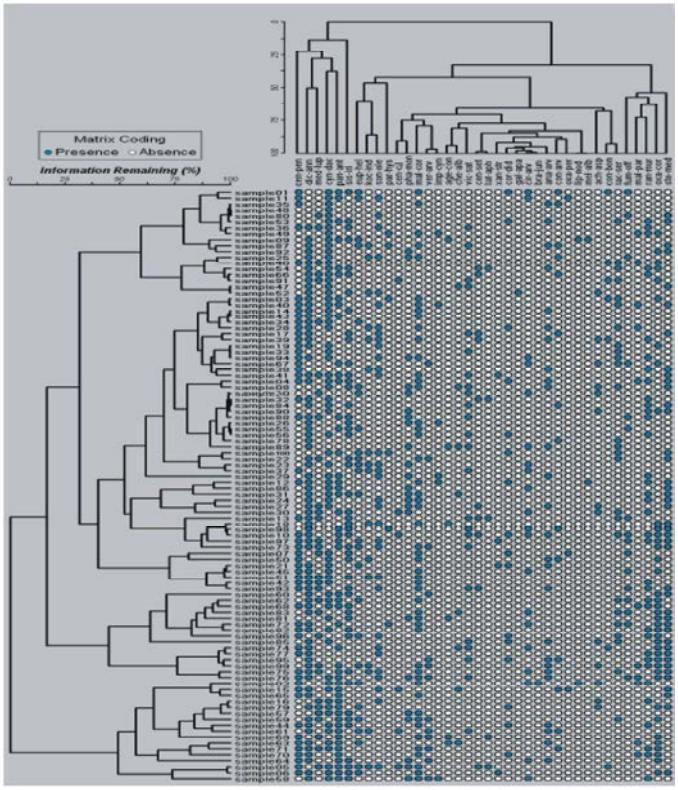

Fig. 2: TWINSPAN classification in Zone-II

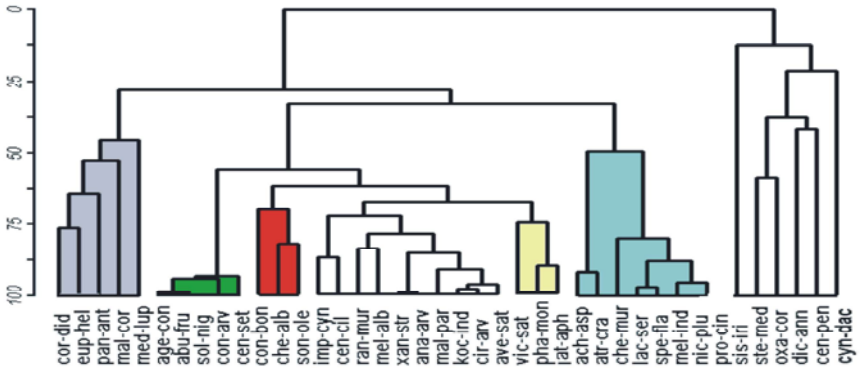

Fig. 3(a): Demarcated vegetation communities in Z-I

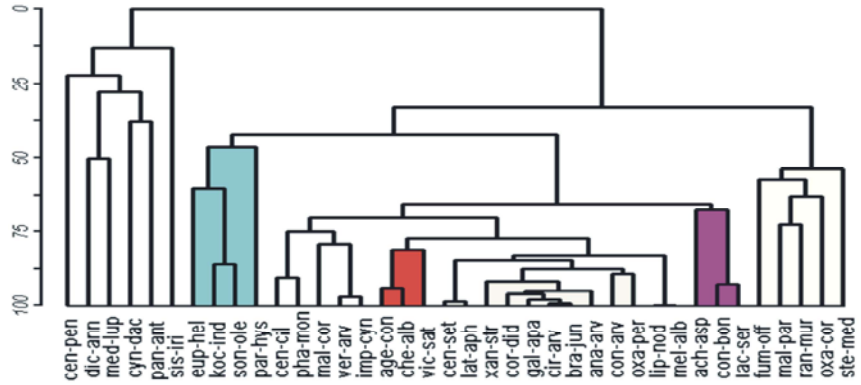

Fig. 3(b): Demarcated vegetation communities in Z-II

TWINSPAN identified the community composition for each zone of the GFP. In each zone of the park, two main groups were identified. Collectively in both groups of the both zones two major and five minor communities were delineated by TWINSPAN. Figure 1 and 2 are showing classification results of Zone-I and Zone-II of study area respectively.

For the purpose of clear understanding, different colors were used to distinguish each community of the major groups of both zones. Figure 3(a) is showing the demarcated vegetation communities by TWINSPAN in Zone-I vegetation of GFP, here the major group-I had been dominated by *Cynodon-dactylon* and *Dichanthium annulatum*. Therefore, it got the name *Cynodon-Dichanthium* (Cyn-Dic). The associated species were *Stellaria media, Oxalis corniculata, Cenchrus pennisetiformis* and *Sisymbrium irio*. On the other hand, the major group-II was assigned the name *Panicum-Malvastrum* (Pan-Mal) due to the dominance of *Panicum antidotale* and *Malvastrum coromandelianum*, with the associated species of *Coronopus didymus*, *Euphorbia heliscopia* and *Medicago lupulina*. Figure 3(b) is showing the demarcation of the vegetation communities in Zone-II. Within the two main groups again two major and five minor communities were found. Major group-I was named as *Dichanthium-Cynodon* (Dic-Cyn) because *Cynodon-dactylon* and *Dichanthium annulatum* were again dominating, with the association of *Cenchrus pennisetiformis, Panicum antidotale, Sisymbrium irio* and *Medicago lupulina.* Group-II is *Malvastrum-Stellaria* (Mal-Ste) as it was being dominated by *Malvastrum coromandelianum* and *Stellaria media*. The associated species were *Oxalis corniculata, Ranunculus muricatus, Fumaria officinalis* and *Malva parviflora.*

From 46 species reported presently, the 42 species found in the present survey were also reported in previous literature for Gatwala herbaceous plants. *Veronica arvensis, Brassica juncea, Lippia nodiflora* and *Galium aparine* were also found from the study areas which were not reported in literature previously. Except *Veronica arvensis* the rest of these appeared once or twice in the sampling. The reason for their unusual presence in the park might be their resistance against grazing, high ecological amplitude or due to anemophily. Similarly, these plants have medicinal values as well. They were collected for ethnomedicinal purposes. This might be another reason for their scarcity in the park. Previously there was lack of extensive research regarding

the taxonomic studies of the ground flora of the particular area. In GFP, many endangered tree species have been planted and because of the dense canopy cover the sunlight penetration is poor, leading towards the complete elimination of the ground/herbaceous flora [26]. Therefore, for the purpose of evaluation of the herbaceous/ground flora of GFP, randomized sampling was done, which was followed by percentage cover estimation of the species present there in at the ground level and then the data was classified by TWINSPAN. It was used by for grouping of species in Ayubia National Park [27]. Similar classification technique delineated the four vegetation groups of 52 herbaceous species of Margalla Hills National Park, Islamabad, Pakistan [28]. Natural vegetation of Hanna Lake was also classified by TWINSPAN in two major and four minor communities [29]. The survey at GFP identified that *Cynodon dactylon, Dichanthium annulatum* and *Cenchrus sp*. were abundant where there was enormous amount of sunlight penetration *Cynodon dactylon* and *Cenchrus sp*. can even grow up generously in wide variety of disturbed habitats [30]. The present study found *Cynodon dactylon* and *Cenchrus pennisetformis* within the same community in association. Ahmad found both of these species in association during the survey of motorway M-2, of Pakistan [5]. Their occurrence in this high degree is supported by the fact that they form a complete cover on the ground where they grow [31]. *Cynodon dactylon* is considered to be a best fodder grass [32]. It can tolerate wide range of environmental conditions along with grazing pressure but *Dichanthium annulatum* does not tolerate shades [33, 34]. The supporting fact for this observation is that, *Panicum antidotale* prefers full sun-drenched areas but not to shades [35]. It is also edible and usually provides fodder in arid surroundings [36]. So this grass species had shown great adaptability to saline and arid soils of GFP [26]. Similarly, *Panicum antidotale* was also found in association with *Dichanthium* and Cenchrus sp. at some locations of GFP. Dabadghao and Shankarnarayan justified this fact as *Panicum antidotale* commonly grows in association with *Dichanthium* and *Cenchrus* grass species with tolerating the grazing stress [37]. In contrast to this, *Stellaria media* found in the park had shown its abundance where there was little interference of sunlight. The fact was justified by the study carried out by King where *Stellaria media* found growing in abundance with little sunlight in study area [38]. Along with *Cynodon dactylon, Dichanthium annulatum* and *Cenchrus sp*., a protropical and short-lived *Malvastrum coromandelianum* weed had the reasonable ground cover in the patches of the park [39, 40]. *Malvastrum coromandelianum* and *Cynodon dactylon* exist in association at specific places without preferring a specific habitat [5]. *Malvastrum coromandelianum* usually prefers gardens, waste places, open fields and along roadsides which has valuable ability to be used as a fodder in the condition of over grazing of the other fodder species [41].

The ordination analysis for the present study, highlighted the dominance of perennial grass species which are resistant to various environments, can grow and survive under stress conditions [36] as they are found naturally in Cholistan desert with huge variations in their appearance [42, 43]. However the heavy grazing pressure can cause damages to all of these species [44-46]. Present survey also observed that the vegetation of the study area was facing infringement, especially from grazing, felling, fodder and urbanization.

CONCLUSION

There is an utter need of paying attention towards the conservation of herbaceous flora as many functions are being performed by the herbs and weeds in maintaining balance in the ecosystem of an area. Therefore, this study will act as a starting point for surveys on the vegetation distribution aimed with the conservation of herbaceous flora of Gatwala forest park. Moreover, this will aid in management practices for the natural ecosystem of the park.

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