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VEGETATION CLASSIFICATION IN AYUBIA NATIONAL PARK, PAKISTAN USING ORDINATION METHODS

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Abstract

Present study was conducted in Ayubia National Park which was declared as a protected/National Park. The study classified the species abundance and its distribution. A total of 59 species that belonged to 32 families were recorded. Overall two major communities were identified using TWINSPAN. Major group 1 comprised of *Hedera nepalensis* and *Adiantum caudatum* and major group 2 comprised of *Plantago major* and *Rumex nepalensis.* The species data was subjected to Nonmetric Multidimensional Scaling, specially used for extracting nonlinear gradients in species composition. The overall data was analyzed by Monte-Carlo test to access the stress in relation to dimensionality. Furthermore overlay matrix was carried out for only two dominant species that is *Adiantum caudatum* and *Hedera nepalensis* to show a relationship in relation to score on a particular axis. The study identifies and highlights the critical need for the protection and conservation of local/native flora in Ayubia National Park.

Introduction

The study highlighted the Ayubia National Park as the solitary moist temperate forest in Pakistan with a high diversity of susceptible plant and animal species. It is located at North of Islamabad in the Galliat Hills (Khyber Pakhtun Khwa Province) of Pakistan. It was blatant as national park in 1984 with the aims of conserving its beautiful sceneries, forests and biodiversity (flora and fauna), education and recreational tenacities. Its advancement ranges between 1,050m to 3,027m. The geographical location of the park is 33^0-52' N- 73^0-90' E.

The aim of this research was to quantify the vegetation in Ayubia National Park using ordination techniques and to quantify the floristics. Study will create consciousness to protect natural vegetation. Increase in population and stipulate of land for infrastructure has resulted in destruction of existing vegetation and inadequate planting sites (Jim, 2000); which has pretentious of the quality of ecological environment and human health (Jackson, 2003). Over the past several decades, an urban collapse has resulted in trouncing of natural vegetation and fragmentation of open green spaces which facilitates environmental and ecological functions (Benedict & Mc Mahon, 2002). Floristic species composition in cities is intimately related with human activities (Hope *et al*., 2003). Ayubia National Park of Pakistan is an amazing area due to its value as well as accepted exquisiteness wherever the scenery, vegetation also fauna are sheltered, preserved in a natural state along with its use for amusement, education and research to the public. There are 25 national parks in Pakistan and Azad Jammu and Kashmir out of which 14 casing an overall district of 2.8 million ha. 0.20 Million ha is the standard dimension of protected area (Rivard *et al*., 2000).Ordination and taxonomy are operational practices for multivariate analyses of community edifice in vegetation ecology (Zhang, 2004). The ordination is valuable in order to attain an approach to parade samples (quadrats) in species space (Giraudel & Lek, 2001). TWINSPAN scrutiny is a polythetic and divisive classification technique and produces indicator species for each sample plan. Documentation of dominant foliage groups of each group separated by TWINSPAN (Rivas-Martı nez *et al*., 2002), names assumed to both group to manufacture an inordinate amount of material for an easier clarification (Santos *et al*., 2006).

Ahmad (2009) studied the relation of herbaceous vegetation with edaphic dynamics of Margalla Hills National Park, Islamabad, using TWINSPAN and DCA. A study was steered by Ahmad *et al*. (2010) scrutinized the vegetation alongside motorway (M-2), Pakistan by means of multivariate procedures i.e.TWINSPAN and DECORANA. Outcomes revealed two major and sixteen sub-communities (divided by TWINSPAN) as of 397 quadrats and 227 plant classes were chronicled. The study was obliging for implementation and preservation planning and for the development of road sides. Enright *et al*., (2005) conducted a study on desert flora and vegetation-environment relationships in Kirthar National Park, Sindh, Pakistan. Analysis of the desert flora of Kirthar National Park, Pakistan, verified 466 plant species in 372 sample quadrats. Cataloguing was done by TWINSPAN and ordination. Khouly & Dawood (2006) carried out study in Sied National Park in Saudi Arabia using TWINSPAN. The study appraises the species diversity of the flora inside the park associating with the vegetation freestanding the park. This study documented the occurrence 21 families are verified in the said Park, while 17 families were recorded outside the park.

Methodology: For the clear communities demarcation study area along Ayubia national park was divided into two zones. Zone 1 of study area was located about 1 m from the walking track. Twenty quadrats were laid down along both sides (10 quadrats on each side).Quadrat method was used for the collection of vegetation data. Quadrat size of 1 × $1m^2$ was selected because mostly herbs and shrubs were present in the area Within each quadrat, cover values of plants were recorded by visual estimation according to Domin Cover Scale (Kent & Coker, 1995). Sampling was carried out in the spring season, when most of the plants are in flowering stages. Species were identified and deposited in herbarium of Fatima Jinnah Women University, Rawalpindi and nomenclature was followed by Nasir & Rafiq (1995). Multivariate analyses were carried out using PC-ORD 5. The data was subjected to TWINSPAN Analysis.

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Results

TWINSPAN analysis was carried out for classification of plant communities using PC-ORD 5 which resulted in a two-way cluster dendrogram. Dendrogram is a hierarchical representation of species and quadrats. It was interpreted for two cut levels.

Zone 1: A total 24 species belonging to different families were recorded from 30 quadrats of zone 1. TWINSPAN classification of zone 1 (Fig. 1) classified the species in two major groups which were further divided into sub-communities. Groups were named after the leading dominant species like Group 1 is designated as *Hedera nepalensis* and *Euphorbia wallichii* along with them other major species are *Poa pratensis*, *Adiantum caudatum* and *Mentho longifolia.* Similarly group 2 was designated as *Urtica dioica* and *Cichorium intybus* along with them other major species are *Plantago major*, *Calamintha vulgaris* and *Polygonatum verticillatum*.

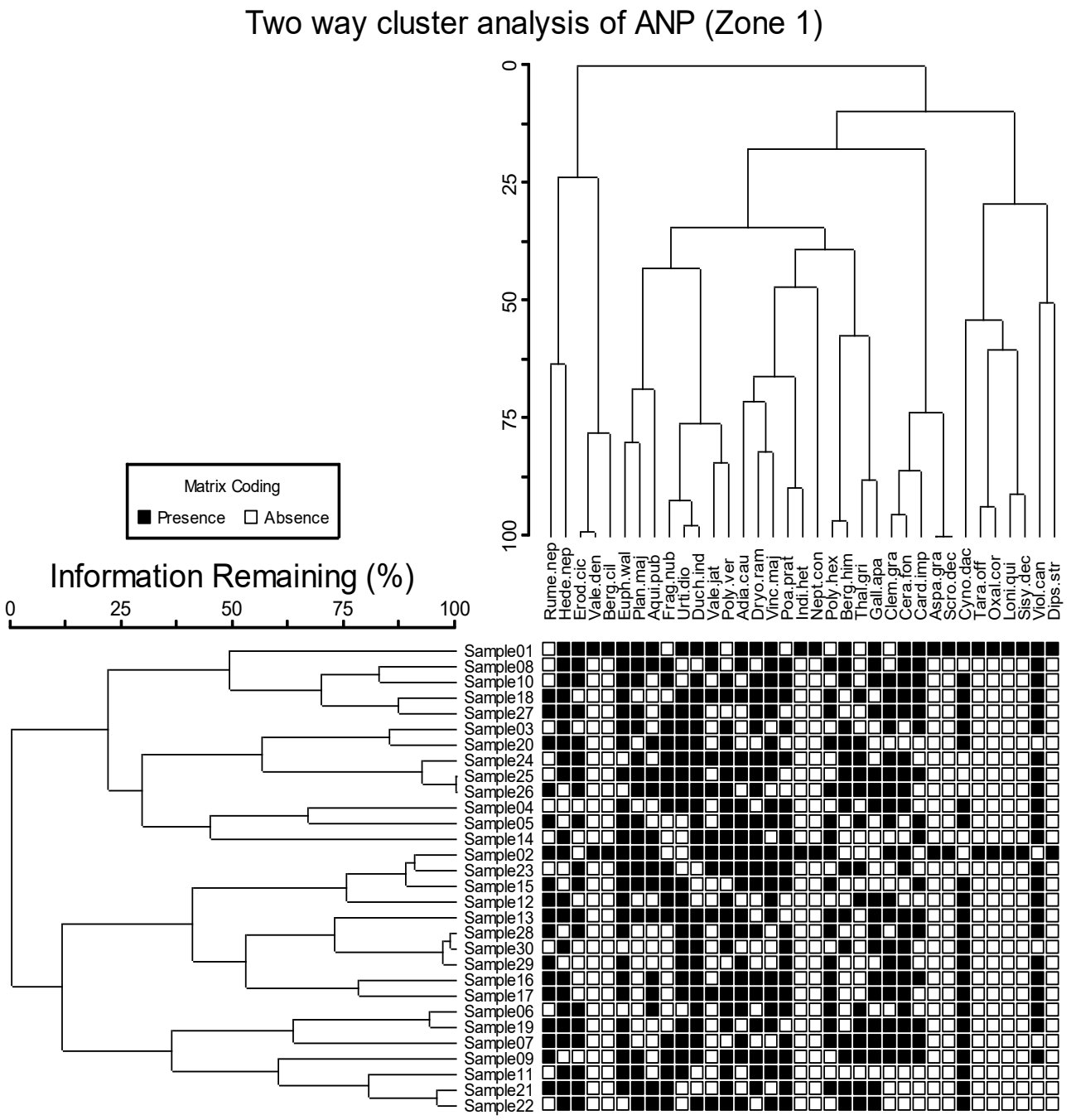

Fig. 1. TWINSPAN analysis of zone 1 species in ANP.

Zone 2: A total of 35 species belonging to different families were recorded from 30 quadrats of zone 2 .TWINSPAN classification divided the (Fig. 2) species in two major groups which were further divided into sub-communities. Groups were named after the leading dominant species like Group 1 is designated as *Rumex nepalensis* and *Hedera nepalensis* along with them other major species are *Viola canscens*, *Euphorbia wallichii*, *Bergenia himalaica* , *Valeriana jatamansi* and *Vinca major*. Similarly second major group was designated as *Poa pratensis* and *Erodium cicutarium* along with them other major species are *Aquilegia pubiflora*, *Dryopteris ramosa* and *Bergenia ciliata*.

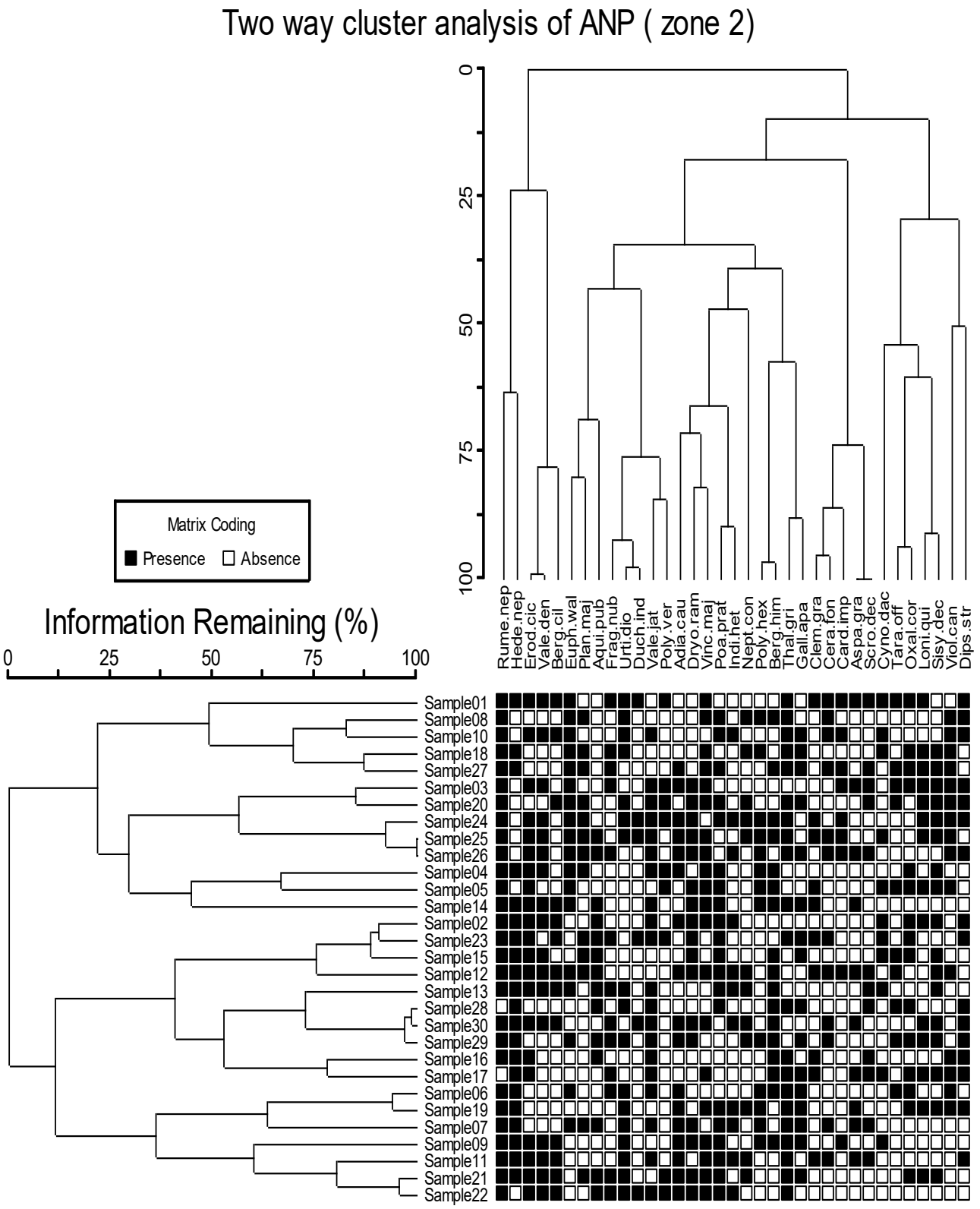

Fig. 2. TWINSPAN analysis of zone 2 species in ANP.

Similarly 43 species recorded in the study area were cumulatively subjected to TWINSPAN analysis for overall species grouping and to identify the major species dominating the vegetation of the area (Fig. 3) categorized the species in two major leading groups which were further divided into sub-communities. Groups were named after the leading dominant species like Group 1 is designated as *Hedera nepalansis* and *Adiantum caudatum* which were further divided into sub-communities *Scrophularia decomposita* and *Duchesna indica*.Second major group sub communities are designated as *Plantago major* and *Rumex nepalensis* these communities are further classified into minor communities like for group 1 sub community divided into *Vibuurnum foetens* and *Adiantun caudatum*.Similarly other sub community of group 2 continues its dominance up to third cut-level as indicated in the dendrogram.

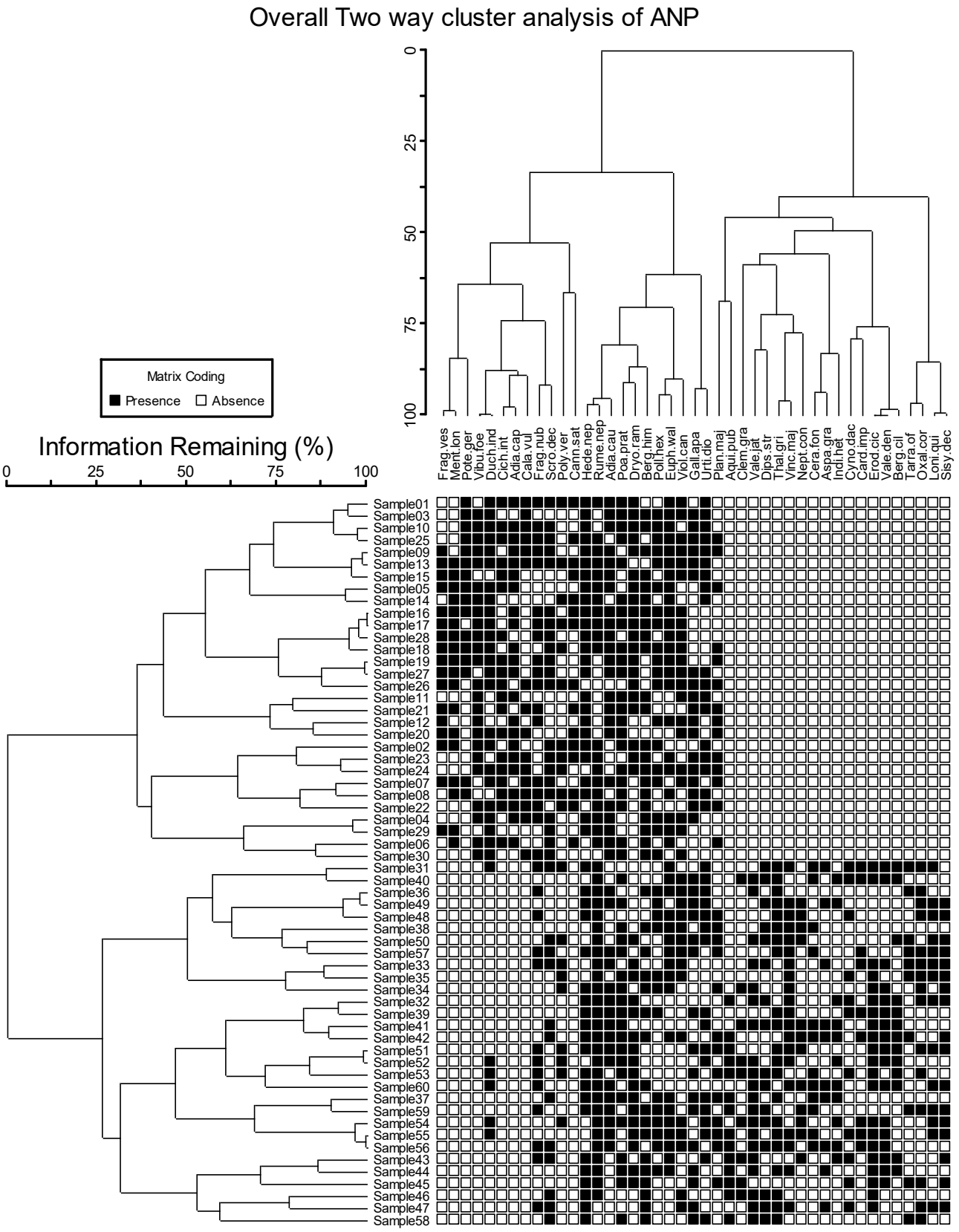

Fig. 3. verall TWINSPAN analysis of species in ANP.

Other major group constitutes Group 3 and 4 designated as *Rumex nepalensis* and *Plantago major* which were further divided into sub-communities *Rumex nepalensis* and *Plantago major*. However these sub-communities continued their dominating profile up to the lower cut-level as the number of the species as well as the composition of different available species as indicated in dendogram i.e. Fig. 3.

One of the most powerful ordination methods is Nonmetric Multidimensional Scaling, specially used for extracting nonlinear gradients in species composition. The overall data was analyzed by Monte-Carlo test to access the stress in relation to dimensionality (Table 1).

Table 1. Stress in relation to dimensionality (Monte Carlo test).

Axes	Minimum	Mean	Maximum	Minimum	Mean	Maximum	P
1	33.113	51.608	56.733	47.496	52.998	56.772	0.0196
2	22.596	23.526	24.572	29.233	31.628	40.577	0.0196
3	17.400	17.667	18.603	20.936	22.951	24.156	0.0196
4	13.722	13.912	14.343	16.533	18.075	19.441	0.0196

p = proportion of randomized runs with stress < or = observed stress
i.e., p = (1 + no. permutations <= observed)/(1 + no. permutations)

The randomization test results showed *p*-values indicated the solutions of any dimensionality from 1 through 4 are stronger than expected by chance. Autoplot chose a 3D solution because it reduced the stress by over 5 units, versus a 2D solution, while still giving a small *p*-value. The minimum stress for the best 3D solution was 17.4. Joint plots for ordinations with three axes can also be produced in 3D.A joint plot superimpose on the ordination a set of radiating lines. These show relationship between variables in the second matrix and the ordination scores (Fig. 4). Individual variables in both the main and second matrix were overlaid on ordinations. Based upon the species richness categorical overlays were carried out using Quantitative overlays. "Side scatter plots" are also shown. These simple.bivariate scatter plots show a variable in relation to score on a particular axis.This overlay matrix was carried out for only two dominant species that is *Adiantum caudatum* (Fig. 5) and *Hedera nepalensis* (Fig. 6).

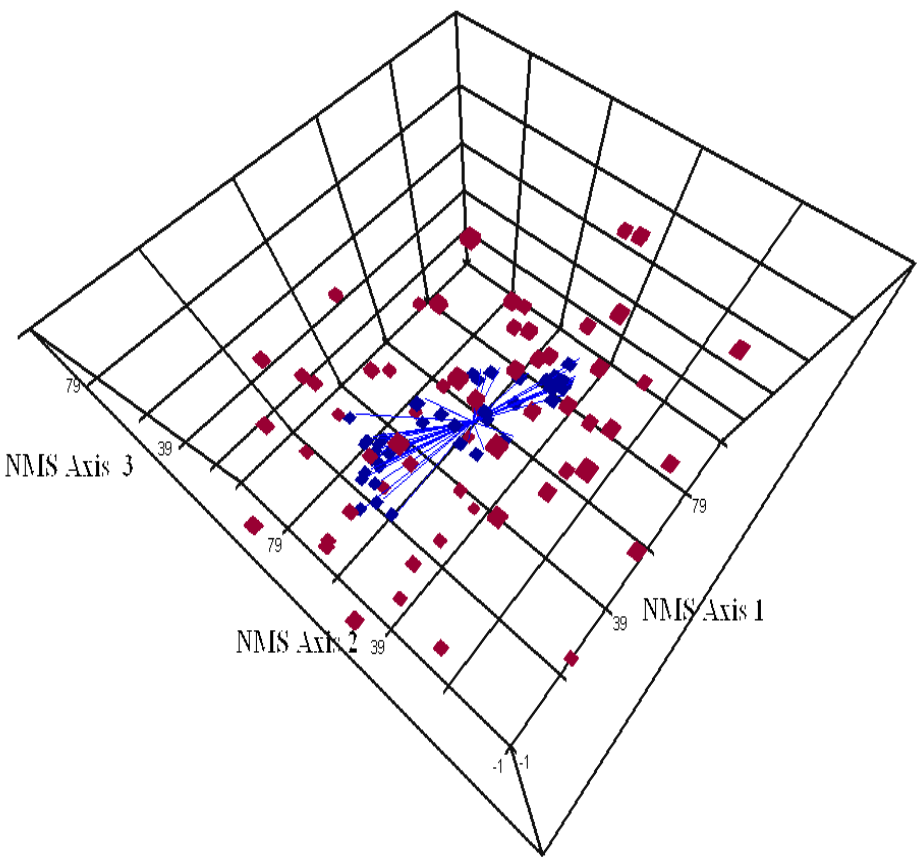

Fig. 4. 3D Joint plot of species using NMS.

Discussions

Present study was conducted in Ayubia National Park which was declared as a protected/National Park. The study classified the species abundance and distribution in the Ayubia National Park. A total of 59 species that belonged to 32 families were recorded. Overall two major communities were identified using TWINSPAN. The application of ordination analysis as a tool is well recognized in the field of plant ecology. The standard and classic researches of Whittaker (1956), Bray & Curtis (1957), the distribution of plant species had quantized by plant ecologists along multiple environmental gradients. In vegetation science, community patterns are correlated with resource gradient and patterns of resource variation has been well established (Gleason, 1926; Whittaker, 1956; Jabeen & Ahmad 2009). The most important method classification and ordination is used to determine distribution of vegetation type and to provide more detail comprehensive information of vegetation types.

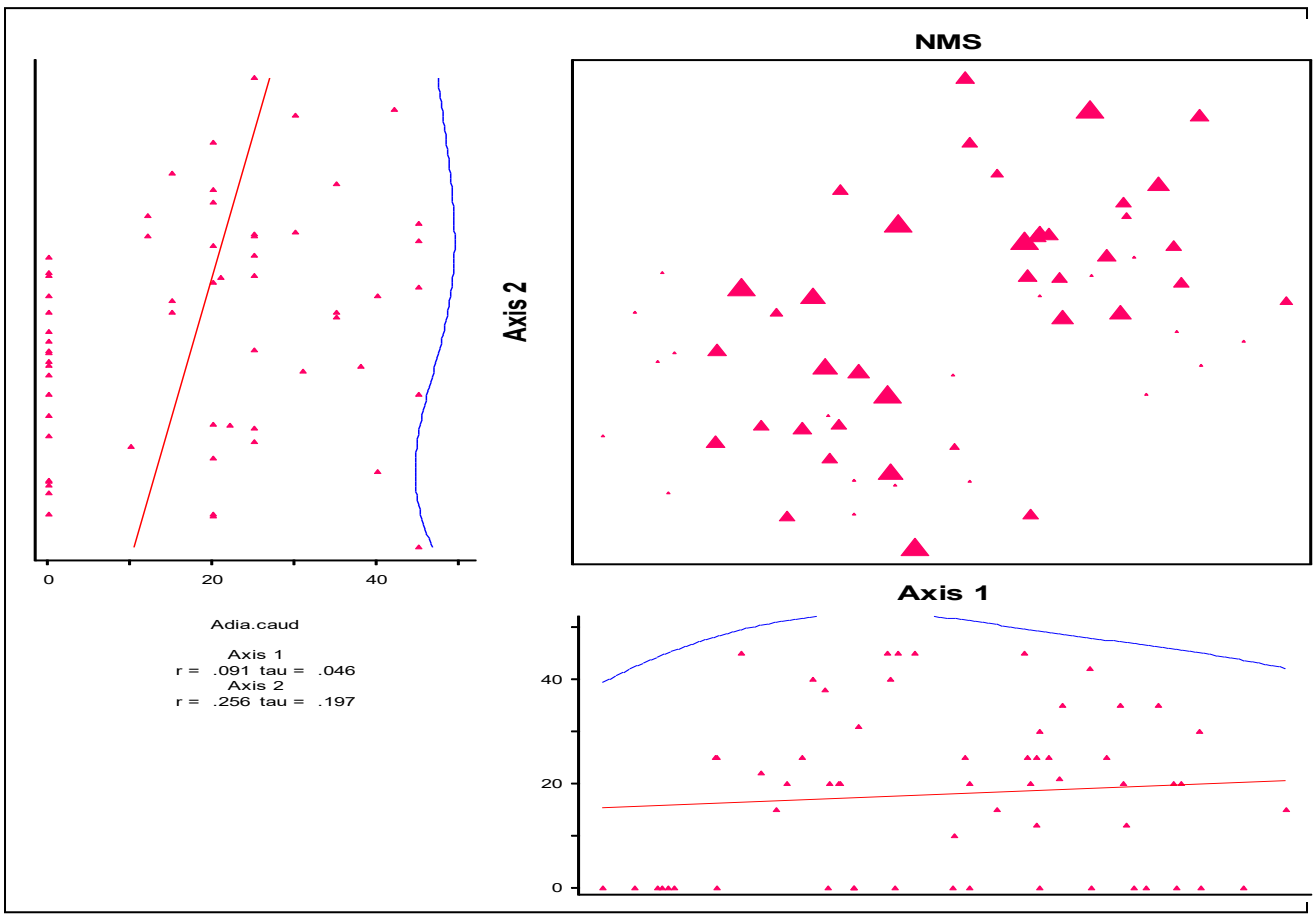

Fig. 5. Overlay of *Adiantum caudatum* using NMS.

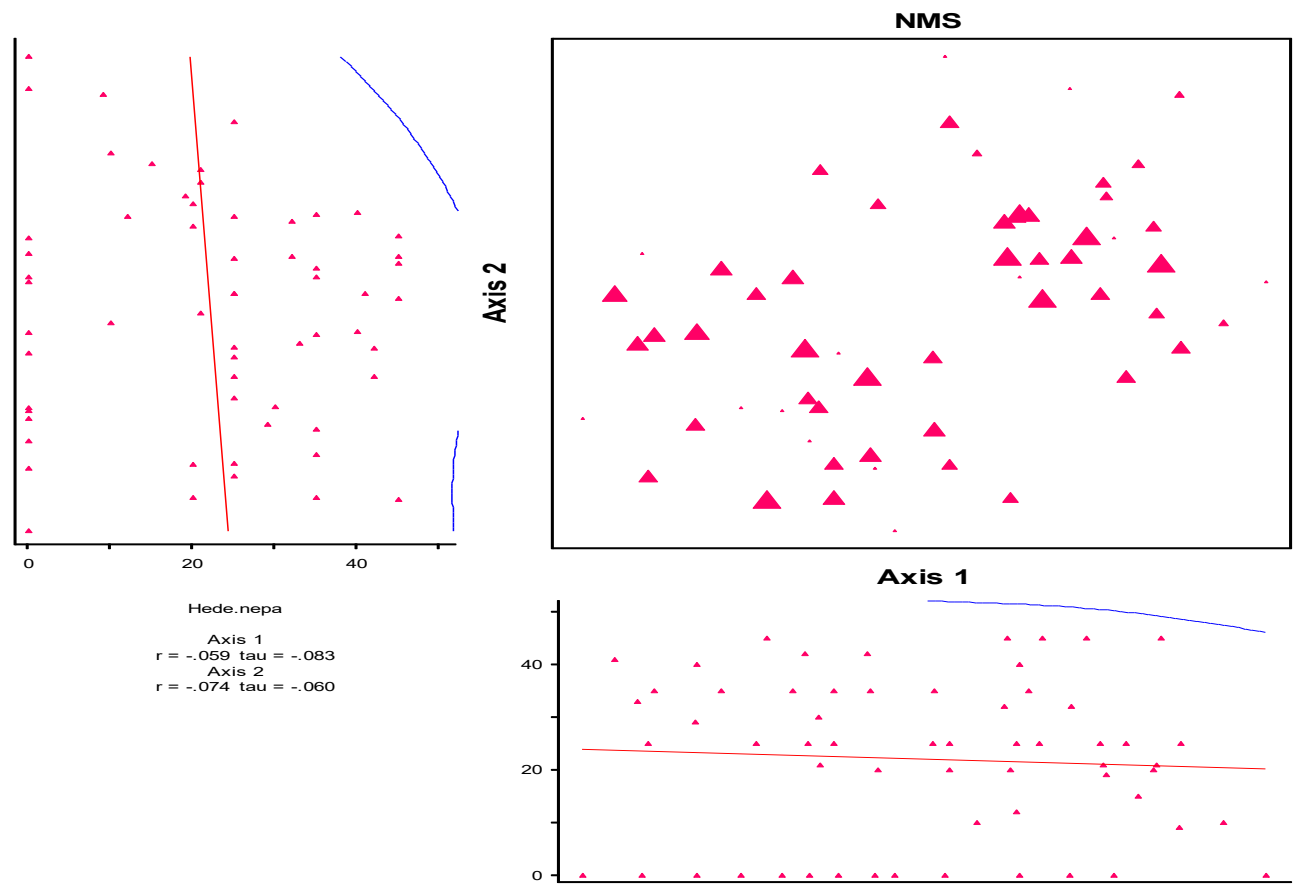

Fig. 6. Overlay of *Hedera nepalensis* using NMS.

TWINSPAN classification of species resulted in demarcation of two major groups in each zone and further divided into sub-communities.The dominant species in group 1 were *Hedera* belong to family Araliaceae and family of *Adiantum* is Pteridaceae , in group 2 dominant species were *Rumex* belonging to family Polygonaceae and *Plantago* family is Plantaginaceae. The dominance of Hedera is supported by the fact that climatic conditions were suitable for its growth and it is used as fodder by the wildlife of park. It consists of large and small forms with large covering walls, tree stumps and small one growing in hanging baskets and containers. It utilize as groundcover, for the foliage also serve the function of attracting wildlife (Ahmad & Javeed, 2007). Similarly the dominance of *Adiantum* was justified by the fact that it grows in moist and low temperatures as in Ayubia National Park and is traditionally used as herbal medicine by the local community (Singh *et al*., 2008). Wild dominant species, Rumex *nepalensis* occurs as a weed in disturbed habitats such as grassland and bush land at 700–4000 m altitude. (Li, 1998; Zhang *et al*., 2008).In present study the dominance of this species is well marked and is usually assumed as medicinally important by local community. The dominance of *Plantago major* grows in low temperatures its leaves have been used as a wound healing remedy by the local inhabitants and in almost all parts of the world and in the treatment of a number of diseases apart from wound healing (Samuelsen, 2000). Hence the study identifies and highlights the critical need for the protection and conservation of local/native flora .This study forms the basis for further studies on the vegetation dynamics of Ayubia National Park in Pakistan.

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