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SPECIES RESPONSE TO ENVIRONMENTAL VARIABLES IN AYUBIA NATIONAL PARK, PAKISTAN USING MULTIVARIATE ANALYSIS

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Abstract

A study was conducted in Ayubia National Park to explore the species response correlation with environmental gradients. Multivariate Analysis was applied to dataset to quantify the vegetation of study area. Vann Dobben circle analysis and T value Biplot was used with the help of Canonical Correspondence Analysis. Two zones were demarcated in Park. Results showed that Species *Plantago major* and *Thlaspi griffthianum* had positive and significant response towards environmental variables and few of species showed negative regression coefficient response to environmental variables. Similarly results of Attribute plot show the species response to particular environmental variable. Dominant spp of Zone 1 *Hedera nepalensis* showed negative association towards organic matter and *Rumex nepalensis* dominant species of Zone 2 *Rumex nepalensis* showed positive and significant response to environmental variables.

Introduction

National parks are area of outstanding natural splendor with immense opportunity for outdoor amusement that requires particular fortification and administration. The new forest has the maximum altitude of protection for the prospect after declaring a National park, to preserve and improve the distinctive environment, especially cultural heritage wildlife and the landscape qualities. Correlation of species richness/abundance along environmental gradient has practically extensive history of growth and development (Austin, 2007). To demonstrate unimodal response pattern along environmental factors, to estimate species optima and tolerances Gaussian models have been frequently use (Ter Braak, 1986). Certainly, many species show asymmetric responses (multimodal patterns) along environmental variables which result further flexible response function that include splines and generalized additive models (Hastie and Tibshirani 1990; Leathwick *et al*.,2005; Zhu *et al*., 2005 and Yee, 2006). A study was conducted in Stockholm archipelago, Baltic Sea by Ericksson *et al*. (2004) to expose the different kind of disturbances on aquatic vegetation. CCA identify that occurrence of species susceptible to meager light surroundings such as *Chara.spp* was negatively correlated with traffic boats or marinas while *Myriophyllum spicatum* was positively correlated with marinas. These results were identified by using T-value Biplot Vann Dobben circle Analysis. Lopes *et al*. (2010) conducted a study on environmental control of diatom species in northeast Pacific sediments.CCA, a constrained ordination technique, discern finest fit associations between a multivariate datasets i.e. the flora and the environmental variables so as to best elucidate the species variance surrounded by diatom populace.

The study expanse Ayubia National Park is the solitary moist temperate forest in Pakistan with a high diversity of susceptible plant and animal species. An aggregate of 757 vascular plant species have been chronicled in park. Around 200 species of herbs and shrubs are originated in park area (Farooque, 2002). The geographical location of the park is 33^0-52' N- 73^0-90' E. Aims of present study was to empirically determine which of the environmental gradient will be mainly appropriate for quantitative analysis of species relative occurrence/richness in the Ayubia National Park, Secondly to quantify ecological / environmental associations due to intercorrelation of variables. And most significantly validate the strength of environmental relationships and ecological estimate with an autonomous dataset.

Material and Methods

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. Sixty quadrats were laid down along both sides (30 quadrats on each side). Quadrat size of $1 \times 1m^2$ 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. Multivariate analysis i.e. Canonical Correspondence Analysis was carried out to investigate the species richness/abundance response to environmental gradients.

Results and 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. Multivariate technique have been used i.e. Canonical Correspondence Analysis.

Ahmad (2009) deliberate relations of herbaceous vegetation with edaphic dynamics of Margalla Hills National Park, Islamabad, exhausting TWINSPAN and DCA ordination. A study was steered by Ahmad *et al*., (2010),they scrutinized the vegetation alongside motorway (M-2), Pakistan by means of multivariate procedures i.e. TWINSPAN and DECORANA .In present study the overall zones of both species were plotted using Van Dobben circles for a selected variable i.e. soil moisture. Species that are represented by arrows which end within one of these 2 circles are predicted to have their T-value statistic larger than 2.0. These techniques are extensively acknowledged and verified way to convert raw statistics into a Biplot representation of distinction (Gower & Hand 1996). Results showed that Species *Plantago major* and *Thlaspi griffthianum* arrow head lie inside the red circle representing preference for higher values of the explanatory variable showing significant, positive regression coefficient response with respect to environmental variables i.e. soil moisture and pH. The other circle of Van Dobben in blue color circle in the tangent at the origin shows preference for lower values of explanatory variables i.e. negative regression coefficient response of species to environmental variables (Fig. 1). To analyze how dissimilar species act in response to change within environmental factors constrained ordination analysis that is technique corresponding to data clustering has been broadly use by ecologist (Zhu *et al*., 2005).

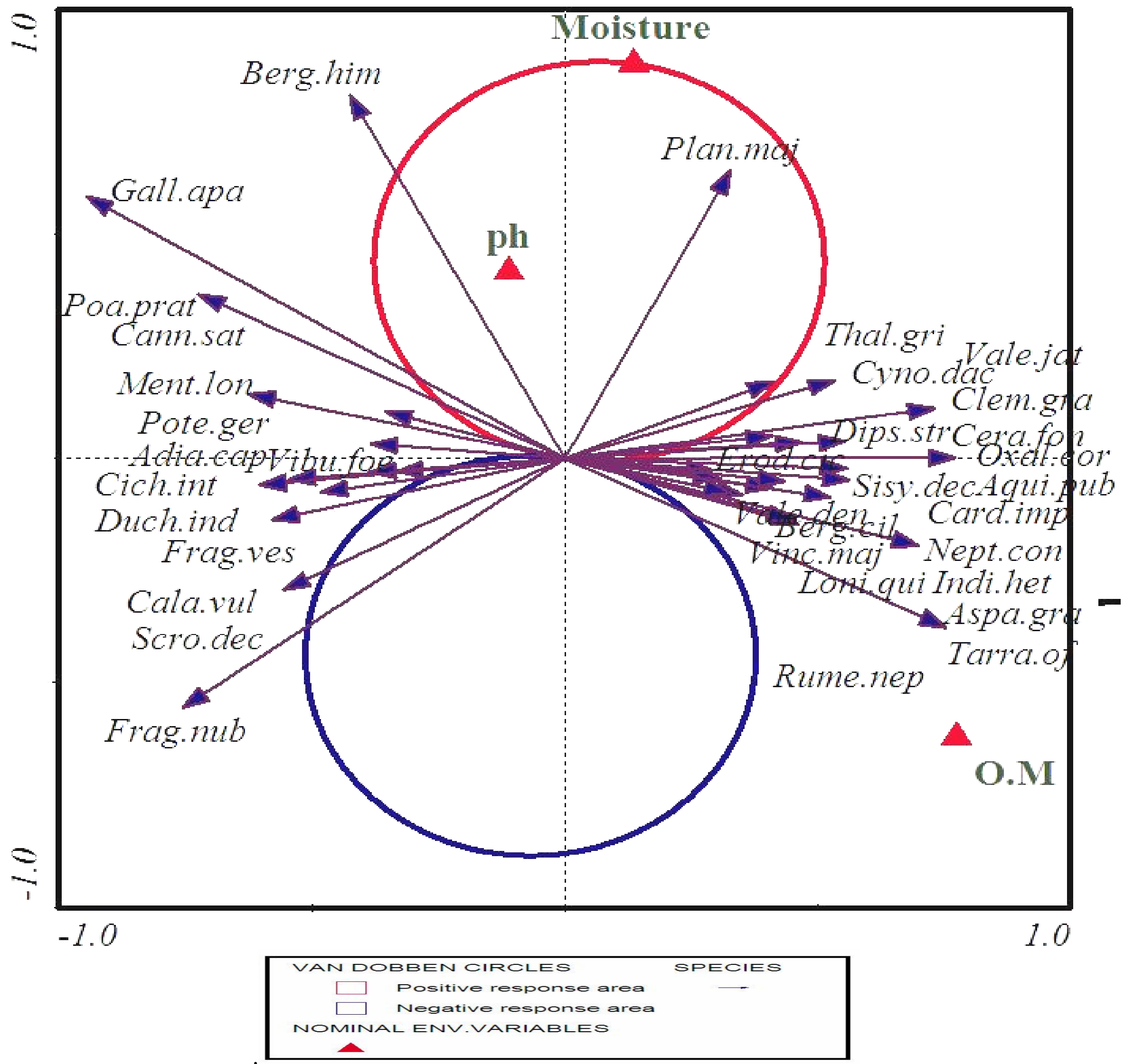

Fig. 1. T-value biplot of all vegetation in Ayubia National Park.

Majority of the species arrow head was outside of the blue circle that shows no negative response of species. With the help of Van Dobben circle Analysis, it is necessary to visualize in particular region genus lie that is momentous as well as affirmative to react to an environmental variable. That region is called as circle that have line segment joining the environmental coordinates for t-value biplot. The species scores and canonical coefficients for environmental variables give a biplot of the matrix of regression coefficients of the multivariate regression. The approximate t-ratio of these regression coefficients are displayed in a biplot. There are different various techniques applied in many environmental researches concerning: vegetation–environment relationships (Hejcmanova & Hejcman 2006; Khaznadar *et al*., 2009; Sheridan & Thomas 2005; Van Etten & Fox 2004), aquatic ecosystems (Girgin *et al*., 2003) and forest ecology (Hamberg *et al*. 2009; Malik & Husain 2006; Pyke *et al*., 2001). Species association with respect to environmental gradients i.e. soil moisture, organic matter and ph was checked using data attribute plot. Each arrow points in the predictable direction of the steepest increase of values of environmental gradient and angles between arrows indicate correlations among individual environmental gradient. Contour plot summarizing a fitted regression model. Similarly many studies on regression analysis were modeled. Guisan & Zimmermann (2000) offer a numerous of the unconventional algebraic approach that might be use. The dominant species of zone 1 *Hedera nepalensis* association to environmental variable showed by contour lines are farther apart result in negative response towards environmental variable it is due to less dense forest cover and availability of organic content is less (Fig. 2). Generalised linear models (McCullagh & Nelder 1989; Austin & Cunningham, 1981) as well as generalized additive models (Hastie & Tibshirani 1990) with logistic regression using presence/absence method is most famous technique used as statistical model (Franklin 1995; Guisan & Zimmermann 2000; Scott *et al*., 2002). Similarly dominant species of Zone 2 *Rumex nepalensis* shows positive and significant response to environmental variables as the contour lines are closer to each other that showed association among the environmental variable organic matter like in sample 8,10 and 12 have strong association with organic content due to dense forest cover and more availability of organic matter (Fig. 3). Guisan & Harrell (2000) and Guisan (2002) identified that cover/abundance measurement is an ordinal variable that require, consequently, extraordinary awareness when selecting the statistical representation.

The use of ordinational correlation elucidated the fact that the environmental variables like soil moisture and organic matter play a significant role in the assemblage of similar species with reference to more pronounced environmental variables .The results justifies the significant relationship between the species grouping and environmental factors.

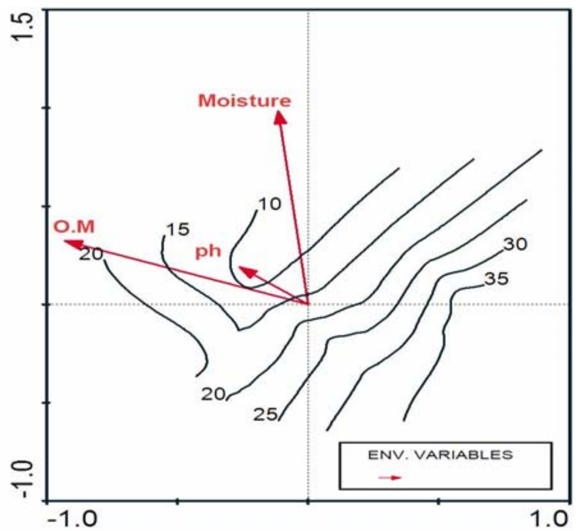

Fig. 2. Contour (3-D) Attribute Plot Diagram of Zone 1 dominating specie *Hedera nepalensis* in Ayubia National Park.

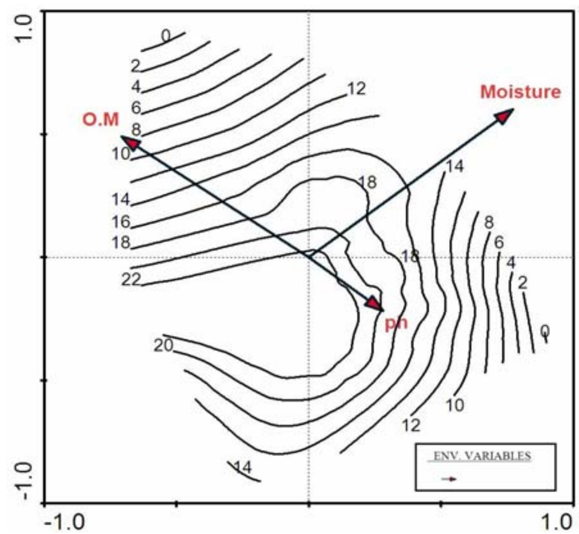

Fig. 3. Contour (3-D) Attribute Plot Diagram of Zone 2 dominating specie *Rumex nepalensis* in Ayubia National **Park.**

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