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Floristic composition and vegetation sturucture of Malam Jabba valley, District Swat

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Abstract

Floristic composition and vegetation structure of Malam Jabba Valley was studied during 2012-13. Vegetation structure was analyzed by using Quadrate method. The study area contains 102 plant species belonging to 39 families. Out of which the most dominant family is Asteraceae which have 7 species followed by Rosaceae possessing 6 species. A total of eight plant Communities were recognized from the results by applying Two Way Indicator Species Analysis (TWINSPAN) classification. In DCA unconstrained analyses the total variation were 9.86. The Eigen value for Axis 1, 2 and 3 were 0.8276, 0.6442 and 0.5295 respectively. Result of CCA ordination clearly indicated that environmental variables has a great impact on the distribution of vegetation. The maximum environmental variable strength were recorded for Nitrogen followed by lime. The minimum environmental variable strength were recorded for organic matter followed by Potassium.

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Introduction

Malam Jabba Valley is located in the North of Pakistan between the Himalayan and the Hindukushbase hills. The elevation of the valley varies from 2000 meter to 3200 meters. The Valley lies between the 34°50´ 47.82˝ North latitude and 72°33´´ 24.54˝ East longitude (Rashid, 1999).

Floristic composition refers to the kinds of species taking place in the community. It is a qualitative (analytical) trait of a community which is hard to determine. A complete list of species is the most important feature of a stand, and creation of such list should be the first step in floristic composition studies. For designing a fine floristic list, it is necessary to collect and examine the plant species during growing season so that all the species growing in different seasons may included. Floristic lists are helpful for description because each species has its own array of ecological amplitude. Each one has its specific interaction to the environment and to other species, so the total number of species, as well as the average number per sample area in each stand, shows a lot about the conditions of the habitat (Hussain, 1989). Floristic composition and vegetation structure are effected by various factors (Haugaasen, *et al*., 2003). The most important of these factors are disturbances, and beside this, intensity and frequency causes local species variation in forest ecosystem (Laidlaw, *et al.,* 2007).

The aim of investigation of vegetation data is to know the density, frequency and abundance (Curtis and McIntosh, 1950). In the assessment of vegetation morphology plant height, basal area, and number of species plays an effective role (Stone and Frayer, 1935). Various vegetation zones are determined by rainfall and moisture (Sheikh and Aleem, 1975).

The applications of advance multivariate techniques (ordination and cluster analysis) are necessary for the detailed understanding of relationship between ecological factors and plant communities. These programs used for the analysis of effect of different environmental factors on the entire group of species as well as for the determination of structure in the data set. These programs show the relation of environmental variables with the vegetation data and reduced the difficulty (Anderson *et al.,* 2006).

There are different classification and ordination method i.e. (cluster analysis and two way Indicator Species Analysis (TWINSPAN), Non-metric Multidimensional Scaling (NMS), and Detrended Correspondence Analysis (DCA) etc. These ordination and clustering methods are presently used mainly in ecological investigation for community analysis (Whittaker, 1967; Orloci, 1978; Gauch, I982). DCA ordination tells us about the pattern in complex data set (TerBraak, 1986). Vegetation structure is a very significant indicator of ecosystem processes which in turn form the structure of vegetation (Sala, 1986). However, no work is carried out on floristic composition and vegetation structure of Malam Jabba. Therefore the present work was planned to explore the floristic composition, vegetation structure and species diversity with respect to altitudinal variation, physiographic and soil factors of Malam Jabba Valley.

Material and methods

Exploratory trips were arranged to different localities of Mallam Jabba Valley during two consecutive years, i.e., 2012-2013.

Sampling method

Quadrate method was used for sampling the vegetation of the selected stands. The quadrate size for trees, shrubs and herbs was taken as 10×2m, 5×2m and 0.5×0.5m respectively. The plant specimen were identified, dried and preserved at Herbarium of Hazara University, Mansehra.

Measurable parameters

Phytosociological attributes (Density, Frequency, Cover, Relative density, Relative frequency, Relative cover and Importance Value Index) were measured for establishment of plant community in each stand. In this step the vegetation data of 102 species was inputted into Microsoft Office Excel 2003 and the calculation for various phytosociological attributes of all the recorded species were obtained (Curtis and McIntosh, 1950; Hussain, 1984).

Data analysis

Data obtained from the area was analysed by the following formulas.

$$\text{Frequency of species (F1)} = \frac{\text{Number of quadrates in which a species occur}}{\text{Total number of quadrates taken}} \times 100$$

$$\text{Relative Frequency of species (F3)} = \frac{\text{Frequency of a species}}{\text{Frequency of all species}} \times 100$$

$$\text{Density of species (D1)} = \frac{\text{Number of individuals of a species in all quadrates}}{\text{Total number of quadrates taken}}$$

$$\text{Relative Density of species (D3)} = \frac{\text{Number of individuals of a species in all quadrats}}{\text{Numbers of individuals of all species in all quadrats}} \times 100$$

$$\text{Cover of species (C1)} = \frac{\text{Cover of a species in a quadrat occur}}{\text{number of individual of a species in a quadrat}}$$

$$\text{Relative Cover of species (C3)} = \frac{\text{Sum of cover of a species in quadrat}}{\text{Sum of cover (square feet) of a species in all quadrats}} \times 100$$

$$\text{Importance value index IVI} = \frac{D3 + C3 + F3}{3}$$

Result and discussion

The study area contains 102 plant species belonging to 39 families. Out of which the most dominant family is Asteraceae which have 7 species followed by Rosaceae possessing 6 species. The associated families are Araliceae, Betulaceae, Boraginaceae, Cannabinaceae, Caprifoliaceae, Ebenaceae, Gentianaceae, Hippocastina ceae, Lamiaceae, Oleaceae, Oxalidaceae, Paeoniaceae and Urticaceae in the valley. Result of TWINSPAN analysis revealed that total eight plant communities were identified in the research area (Fig. 1). Following are the details of the communities recorded from the study area.

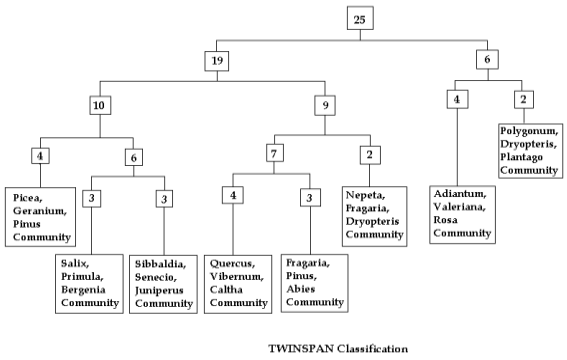

Fig. 1. TWINSPAN analysis identified eight plant communities in the research area.

Community No 1. Polygonum, Dryopteris, Plantago community

The community was recorded at an altitude of 2000-2200m.

A total 16 plant species were recorded for this community with 1 tree, 6 shrubs and 9 herbs plant species. The dominant plant species were *Polygonum aviculare*, *Dryopteris jaxtaposita*, *Plantago lanceolentam*, having importance value (IV) 4.60%, 3.47% and 2.51% respectively. The co-dominant species were *Urtica dioca* and *indigofera heterantha* having IV 2.18% and 2.08% respectively. Total IV of trees was 0.75%, shrubs 5.79% and herbs 19.05.

Community No 2. Valeriana, Adiantum, Rosa community

The community was recorded at an elevation of 2200-2300m. A total of 10 plant species were found in this community, comprising of 1 tree, 4 shrubs and 5 herbs. *Valeriana jatamansii, Adiantum venestum, Rosa webbiana* were dominant plant species of this community having importance value of 19.67%, 17.85%, and 5.46% respectively. The co-dominant species were *Gerenium wallachianum*, *Desmodium elegans*, *Jasminium humile*, *Aesculus indiaca, Indigofera heterantha, Euphorbia wallichi, and Rumex hestatus* having importance value of 3.50%, 3.17%, 3.17%, 2.49%, 1.93%, 1.83% and 0.60%. Total IV of trees was 2.49%, shrubs 13.73% and herbs 43.45%.

Community No 3. Nepeta, Fragaria, Dryopteris community

The community was recorded at altitude of 2300 to 2450m.

A total of 17 plant species were recorded in this community with 2 shrubs and 15 herbs species. The dominant species were *Nepeta erecta, Fragaria nubicola* and *Dryopteris stewartii* having importance value 13.71%, 5.66% and 5.0% respectively. The co-dominant species was *Pimpinella accuminata* having importance value of 3.89%. Total IV of shrubs was 4.45% and herbs 21.32%.

Community No 4. Pinus, Fragaria, Abies community

The community was recorded at altitude of 2450 to 2600m. A total of 31 plant species were present in this community, comprising of 5 tree, 4 shrubs and 22 herbs. The dominant species of this community were *Pinus wallachiana, Fragaria nubicola* and *Abies pindrow* with importance value of 57.89%, 49.1%, and 32.51% respectively. The co dominant species were Viola canasence, Vibernum grandifloram and *Rosa webbiana* having importance value of 26.12%, 18.24% and 8.65%. Total IV of trees was 94.54%, shrubs 29.95% and herbs 122.24%.

Community No 5. Quercus, Vibernum, Caltha community

The community was recorded at altitude of 2600 to 2750m. This community consists of 28 species comprising of 4 trees, 2 shrubs and 22 herbs species. The dominant species of this community were *Quercus semicarpifolia, Vibernum grandifloram* and *Caltha alba* having importance value of 91.7%, 50.1% and 32.63% respectively. The co-dominant species were *Viloa canasence*, *Taraxicum officinale* and *Aconitum heterophyllum* having importance value 23.15%, 11.07% and 10.53%. Total IV of trees was 102.59%, shrubs 54.74% and herbs 113.82%.

Community No 6. Sibbaldia, Juniperus, Senecio community

The community was recorded at an altitude from 2750 to 2900m. A total of 19 plant species were present in this community, comprising of 2 trees species, 4 shrubs and 13 herbs species. The dominant species were *Sibbaldia cunneata, Juniperus communis* and *Senecio chrysenthemoides* having importance value of 66.7%, 37.67% and 29.78% respectively.

The co-dominant species were *Bergenia ciliata, Lindelofia longiflora* and *Salix flabellaris* having importance value of 24.14%, 21.9% and 19.83% respectively. Total IV of trees was 20.28%, shrubs 63.74% and herbs 217.83%.

Community No 7. Salix, Primula, Bergenia community

The community was recorded at an altitude ranging from 2900 to 3000m. This community is composed of 14 plant species comprising of 1 tree, 3 shrubs and 10 herbs. The dominant species were *Salix flabellaris, Primula denticulata, Bergenia himalyca* with importance value of 42.13%, 19.83% and 16.43% respectively. The co-dominant plant species were *Berberis lycium, Picea smithiana* and *Arisaema flavum* with importance value of 16.3%, 12.7% and 7.29% respectively. Total IV of trees was 12.7%, shrubs 61.36% and herbs 64.4%.

Community No 8. Picea, Geranium, Pinus community

The community was recorded at an altitude ranging from 3000 to 3200m. A total of 17 plant species were recorded in this community comprising of 3 tree, 1 shrub and 13 herbs. The dominant species of the community were *Picea smithiana, Geranium nepalensis and Pinus willachiana* with importance value 31.65%, 7.12% and 4.58% respectively. The co-dominant species were *Peonia emodi, Caltha alba* and *Skimmia lareola* having importance value 5.92%, 3.08% and 2.23%. Total IV of trees was 63.47%, shrubs 1.95% and herbs 29.93%.

Ordination analysis

Response data are compositional and have a gradient 12.1 SD units long, so linear method is not appropriate. For ordination of samples DCA were used to analyze the ordination of species and samples. In DCA unconstrained analyses, the total variation were 9.86. The Eigenvalue for Axis 1, 2 and 3 were 0.8276, 0.6442 and 0.5295 respectively. The explained variations (cumulative) for the same axis were 8.40, 14.93 and 20.30. The Gradient length for axis 1, 2 and 3 were 12.11, 6.04 and 6.48.

The DCA analysis showed that all the samples were dominated by a single gradient length for axis 1. The graphical representation of DCA analysis is represented in Fig.2. DCA ordination of species in space showed the correlation of different species. Urtica dioca and Dryopteris jaxtaposita were clustered together. *Picea smithiana* and *Primula denticulata* clustered together along with many other species. No close association was recorded for *Jasminum humile*.

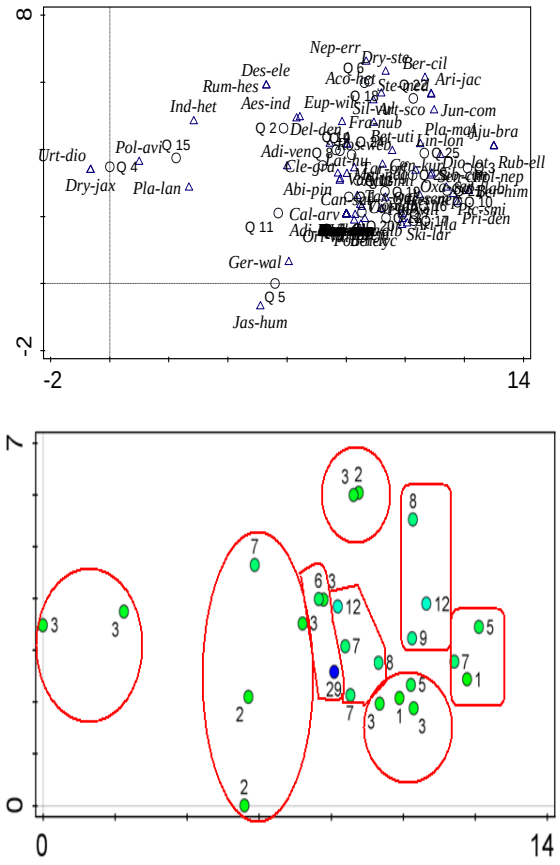

Fig. 2. DCA ordination of species and stands DCA ordination of stands showing different plant communities.

CCA Ordination of samples

In CCA ordination the total variation were 9.86, explanatory variables account for 33.3%. The maximum eigenvalues were recorded for axis 1 was (0.67) followed by axis 2 (0.57) and axis 3 (0.49). The explained variation for axis 1, 2 and 3 were 6.83, 12.64 and 17.65 respectively. The pseudo-canonical correlation for axis 1, 2 and 3 were 0.98, 0.96 and 0.94 respectively. The permutation test results for all axis were pseudo-F=1.0, P=0.408.

From CCA ordination, it was clearly indicated that a particular environmental variables has a great impact on the distribution of vegetation in the study area. The maximum environmental variable strength were recorded for Nitrogen followed by lime. The minimum environmental variable strength were recorded for organic matter followed by Potassium. The environmental variables such as lime, Phosphorus, pH and TDS are positively correlated with each other while weakly correlated with organic matter, electrical conductivity, Potassium and Nitrogen.

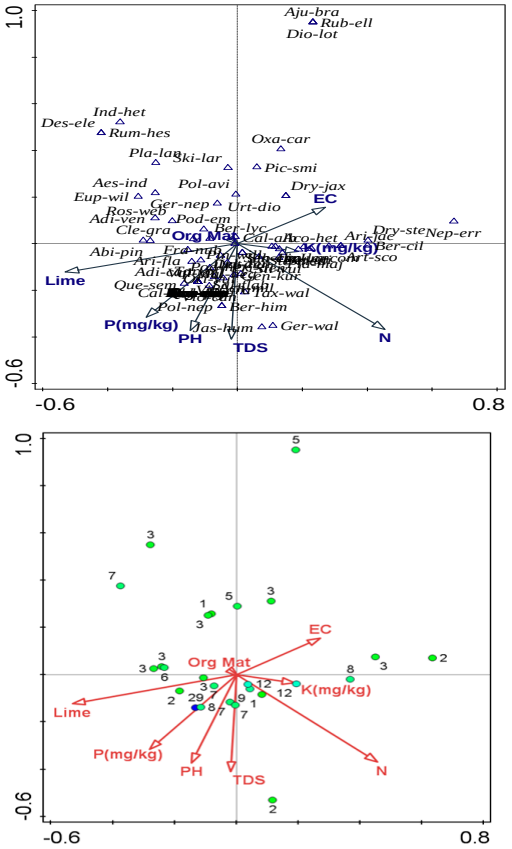

Fig. 3. CCA Ordination of species along CCA ordination of Samples along environmental variables environmental variables.

Abies pindrow, Arisema flavum, Fragaria nubicola were positively correlated with lime. *Quercus semicarpifolia* was positively correlated with Phosphorous. *Taxus wallichiana, Bergenia himylaca, jasminum humale* were positively correlated with pH and TDS. *Caltha alba, Aconitum heterophylum, Dryopteris jaxtaposita* were positively correlated with Potassium and electrical conductivity.

Berberis lyceum, Peonia emodi were positively correlated with organic matter. *Ajuga bracteosa, Rubus ellepticus* and *Diospyrus lotus* were negatively correlated with most of the environmental variables as shown in Fig 3.

Discussion

Malam Jabba valley lies in moist temperate zone. There is no barrier for the protection of the flora from human and livestock interference such as cows, buffaloes, and goats etc that freely wander here and there in study area. Massive amount of rain and snow prevails in the valley thus providing a fine drainage system. The area comprises of a variety of topography from moderate to steep and hilly slopes. The vegetation of the valley differs from place to place however the area is full of rich vegetation.

In the present study the IVI of 102 plants species was subjected to multivariate analysis (cluster analysis and ordination), which resulting in to the formation of eight communities. The name of the community was represented by the dominant and co-dominant species of the community.

Results showed that Mallam jabba valley is composed of eight plant communities. The floristic study of the investigated area shows that the area support 102 species distributed in 39 families. Among these families the dominant family is Asteraceae sharing 7 species followed by families Rosaceae sharing 6 species. Shah and Rozina (2013) reported Asteraceae and Poaceae the dominant families from Dheri baba hill and Peer Taab Graveyard, District (Swabi). Barkat Ullah and Ibrar (2011) found Asteraceae and Lamiaceae the richest dicot families 12, 11 species respectively in Malakand pass hills. Shaheen and Shinwari (2012) also found family Asteraceae as a richest family while studying the phytodiversity and endemic richness of Karambar lake vegetation from Chitral, hindukush-himalayas. Family Asteraceae was also reported by Hussain and Frrag (2012) from Wadi Al-Argy of Taif region, Saudi Arabia. All these studies show that family Asteraceae is the largest family in Pakistan as well as throughout the world.

The other closely associated families were Araliceae, Betulaceae, Boraginaceae, Cannabinaceae, Caprifoliaceae, Ebena ceae, Gentianaceae, Hippocastinaceae, Oleaceae, Oxalidaceae, Paeoniaceae and Urticaceae in the valley.

The degree of maturity index showed the highest value for Salix-Primula-Bergenia community was 30.61. The lowest maturity index value was recorded for *Polygonum-Dryopterus-Plantago* that was 16.87. The immaturity of all the communities in the study area is considered to be mature if it exceeds than 60% (Pichi Sermolli, 1948).

Multivariate analysis including clustering and ordination analysis method developed by is a best method for objective categorization (Okono, 1996). Shaukat (1985) also suggested that clustering and ordination analysis are two basic techniques complementary to each other though fundamentally applied for different purposes. Multivariate techniques exceedingly use to expose the underlying structure of groups and the main environmental factors which are responsible for the distribution of vegetation communities (Khan *et al* 2013; Salonen 1993).

The result of species association and with their environmental factors is strongly supported by ordination analysis (CCA and DCA). Result of the DCA ordination show that environmental variables such as lime, Phosphorus, pH and TDS are positively correlated with each other while weakly correlated with organic matter, electrical conductivity, Potassium and Nitrogen. *Abies pindrow, Arisema flavum, Fragaria nubicola* were positively correlated with lime, *Quercus semicarpifolia* was positively correlated with Phosphorous. *Taxus wallichiana, Bergenia himylaca, jasminum humale* were positively correlated with pH and TDS. *Caltha alba, Aconitum heterophylum, Dryopteris jaxtaposita* were positively correlated with Potassium and electrical conductivity. *Berberis lycium, Peonia emodi* were positively correlated with organic matter. *Ajuga bracteosa, Rubus ellepticus* and *Diospyrus lotus* were negatively correlated with most of the environmental variables.

Conclusions and recommendations

Malam jabba is a moist temperate zone that provides a good habitat for medicinal plants, timber extraction and recreational activities. Due to its climate, the area has a great potential for providing thick vegetation and a source of various products which contributes much to the economy. Beside this, the valley is also very productive in herbaceous vegetation which is used in various medicines for treatment purposes. Although local people and most traders are collecting them for their use but it needs special attention from Government side because they have the same importance as timber, fuel wood etc.

During this study it comes in observation that a single man keeps the supervisory duty for whole valley which is quit impossible. So the supervisory staff must be increased and provided with all possible facilities. Local staff should be aware about the conservation of plants resources of the area.

Most of the people of the valley are illiterate and their main profession is farming. Due to high illiteracy rate, the local people lack awareness about conservation of the flora. Keeping in mind this problem, there is a need of different firms like WWF and IUCN to work on the limited resources of the valley and to ensure the local community on the importance of the flora. Currently no proper management system for the conservation of the flora exists in the valley except up to some level from the provincial forest department. So there is a need to attract national and international firms which are working for the improvement and conservation of natural resources, This will result the management for in-situ conservation of the flora.

Abbreviation

Two Way Indicator Species Analysis (TWINSPAN), Detrended Correspondence Analysis (DCA), Canonical Correspondence Analysis (CCA)

References

Anderson MJ, Ellingsen KE, McArdle BH. 2006. Multivariate dispersion as a measure of beta diversity. Ecology Letters **9,** 683-693.

Barkatullah, Ibrar M. 2011. Plants profile of Malakand Pass Hills, District Malakand, Pakistan. African Journal of Biotechnology **10,** 16521-16535.

Curtis JT, McIntosh RP. 1950. The interrelation of certain analytic and synthetic phytosociological characters. Ecology **31(3),** 435-455.

Gauch. 1982. Multivariate Analysis in Community Ecology. New York: Cambridge University Press.

Haugaasen T, Barlow J, Peres CA. 2003. Surface wildfires in central Amazonia: Short-term impact on forest structure and carbon loss of Ecological Management **179**, 321-331.

Hussain F. 1989. Field and Laboratory manual of plant ecology NAHE, UGC Islamabad pp. 422.

Hussain SS. 1984. Pakistan Manual of Plant Ecology. National Book Foundation, Islamabad pp. 1-242.

Hussein F, Farrag. 2012. Floristic composition and vegetation-soil relationships in Wadi Al-Argy of Taif region, Saudi Arabia. International Research Journal of Plant Science **3,** 147-157.

Khan N, Shaukat SS, Ahmed M, Siddiqui MF. 2013. Vegetation-environment relationships in the forests of Chitral district Hindukush range of Pakistan. Journal of Forestry Research **24**, 205–216.

Laidlaw M, Kitching R, Goodall K, Small A, Stork N. 2007. Temporal and spatial variation in an Australian tropical rainforest. Australian Ecology **32,** 10–20.

Okono T. 1996. Quantitative analysis of topographical factors and their influence on forest vegetation. International symposium. Interpraevent 1996-Garmisch-Partenkirchen. Band 1, Seite pp. 205-214.

Orloci L. 1978. Multivariate Analysis in Vegetation Research. 2nd ed. Junk, The Hague.

Pichi Sermon R. 1948. An index for establishing the degree of maturity in plant communities. J. I Col **38**, 85-90.

Rashid. 1999. Resource Management Plan for Swat Forest Range p-3.

Sala OE. 1986. Grazing effects upon plant community structure in sub humid grasslands of Argentina. Vegetation **67,** 27-32.

Salonen J. 1993. Weed infestation and factors affecting weed incidence in spring cereals in Finland: A multivariate approach. Agriculture Science Finland **2,** 525-536.

Shah M, Rozina. 2013. Phytosociological attributes and phytodiversity of Dheri baba hill and Peer Taab Graveyard, District Swabi, Khyber Pakhtunkhwa, Pakistan. PJLS **01,** 1-16.

Shaheen H, Shinwari ZK. 2012. Phytodiversity and endemic richness of Karambar lake vegetation from Chitral, Hindukush-Himalayas. Pak. J. Bot **44,** 15-20.

Shaukat SS. 1985. Approaches to the analysis of ruderal weed vegetation in London Ontario. Ph. D Thesis, University of Western Ontario, Canada pp. 1-112.

Sheikh MI, Aleem A. 1975. Forest and forestery in Northern Areas (Part 1). The Pakistan Journal of Forestery 197-235

Stone WC, Frayer JRA. 1935. A botanical study of pasture mixtures, Science and Agriculture **15,** 777-805.

Ter Braak CJF. 1986. Canonical correspondence analysis: a new eigenvector technique for multivariate direct gradient analysis. Ecology **67,** 1167–1179.

Whittaker RH. 1967. Gradient analysis of vegetation. Biological Reviews **42,** 207-264.