Journal of Biodiversity and Environmental Sciences (JBES)
ISSN: 2220-6663 (Print) 2222-3045 (Online)
Vol. 7, No. 3, p.271-279, 2015
http://www.innspub.net

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RESEARCH PAPER

OPEN ACCESS

Assessment of vegetation dynamics along altitudinal gradients in Danyore Valley Gilgit-Baltistan, Pakistan

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Article published on September 28, 2015

Key words: Vegetation dynamics, Altitudinal gradients, Density, Frequency,Cover.

Abstract

This study was conducted in Danyore Valley, situated some 10 Kilometers North of Gilgit city, and encompasses an areaof 22484 hectare. Data for grasses and trees about parameters of density, frequency and cover was collected on three altitudinal levels, starting from 1450 meters to 3660 meters during late summer and mid-spring seasons.

Square shape quadrats with sizes of 100 square meters were laid with alternate pattern on transects for trees and shrubs; whilesquare shape quadrats of 1 square meter were laid for grasses, herbs, and forbs. Transects for all types of vegetation were laid equally on water points, slopes and valley plains. The maximum site density, frequency and cover was found on water points, then on plains sites and minimum on slope sites on all three altitudinal levels. The seasonal density frequency and cover was observed maximum during summer season and minimum during spring season. The density, cover and frequency for different altitudinal levels, density was found maximum at level-3, followed by level-1 and least at level-2. Frequency was studied maximum at level-2, preceded by level-1 and lowest at level-3. Cover was found maximum at level-3, preceded by level-2 and lowest at level-1.

The species variation from site to site and level to level probably was because of the different soil type, soil composition, altitudinal variation, soil moisture, varying climate, anthropogenic influences and impacts, livestock rate per level and site and their grazing patterns and preferences.

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Introduction

Vegetation is the most precious gift for humans in the form of food, fuel, shelter, medicine and various other products (Gaur, 1999). Flora plays a primary role in determining the history of many more of invertebrate species, as it serves as base of many food webs (Huston, 1994), and thereby playing a vital role in welfare and economic development of humans. It is estimated that Pakistan contains some 6000 plant species with 400 (7.8%) endemic species confined to the region (Stewart, 1972), out of which 5,600 species, belonging to 22 families and nearly 150 genera have been enlisted by various researchers. About 80% of flora in Pakistan is situated in Northern region (Ali and Qaiser, 1986).

In a study conducted (Shaheen *et al.,* (2011). in Rama valley, Gilgit-Baltistan, Pakistan to explore the vegetation diversity and endemic richness in high altitudes of Western Himalayas, the analyzed data revealed a heterogeneous vegetation structure and distribution because of complex environmental patterns. About 83 species belonging to 31 families were found. The recorded species diversity index was 1.02 to 2.17, while species richness recorded was 1.9 to 1.97. Both parameters' values were very low compared to other Himalayan regions. Further analysis with detrended correspondence analysis (DCA) resulted in slope steepness and moisture variability as main factors controlling vegetation distribution and structure.

On overall level, diversity and richness were found negatively correlated with altitude steepness and moisture content, while evenness was found positively correlated with altitude steepness and moisture content. In mountainous regions, vegetation is controlled mainly by rainfall and redistribution of water that has been observed decreasing with increase in altitude. The annual mean temperature tends to decrease with increasing altitude. It is an altitude-based temperature gradient structuring and shaping the vegetation, thus determining their diversity and distribution (Heaney and Proctor, 1989; Tanner *et al.*, 1998; Vazquez and Givinish, 1998). Diversity and richness of vegetation are the direct measures of livestock and anthropogenic impacts on the ecosystems (Buntaine *et al.,* 2007).

In a study, using line transect method to know the effect of altitude and topography on species richness of vascular plants, bryophytes and lichen species; it was revealed that patterns in species richness of a place results from two opposing forces i.e. declining species pool and decreasing intensity of competition along altitude. Along with it was also found that plant diversity was at peak in intermediate altitudes, but with considerable variation over functional groups. Significant relationship between altitude and topography were found.

The overall pattern for all species richness and diversity was interpreted in terms of local productivity, physical disturbance, trophic interactions, and in terms of species pool effects (Henerik *et al.*, 2006). Measurements of species richness and dynamics are scale dependent, as are the relationships between species attributes and environmental factors (Whittaker *et al.*, 2001).Keeping in view the phyto-geographical importance of the study area, the current study was been planned to explore the seasonal change in vegetation density, frequency and cover along altitudinal gradients of the study area.

Materials and methods

Study area

The study was conducted in Danyore Valley, located some 10 kilometers North of Gilgit city, Gilgit-Baltistan, Pakistan, surrounded by peaks of the Karakorum Range. It lies between 35° 91'Nto 36° 06' N latitudes and 74° 23' E to 74°39'E longitudes with altitudes of 1450to 1509 meters at river banks up to 4500at higher altitudes up to the rear side base of famous Rakaposhi peak (7400m). Total area of the valley is about 22484 hectares. It is important to mention that this was the first ever study in the study area in assessing vegetation dynamics.

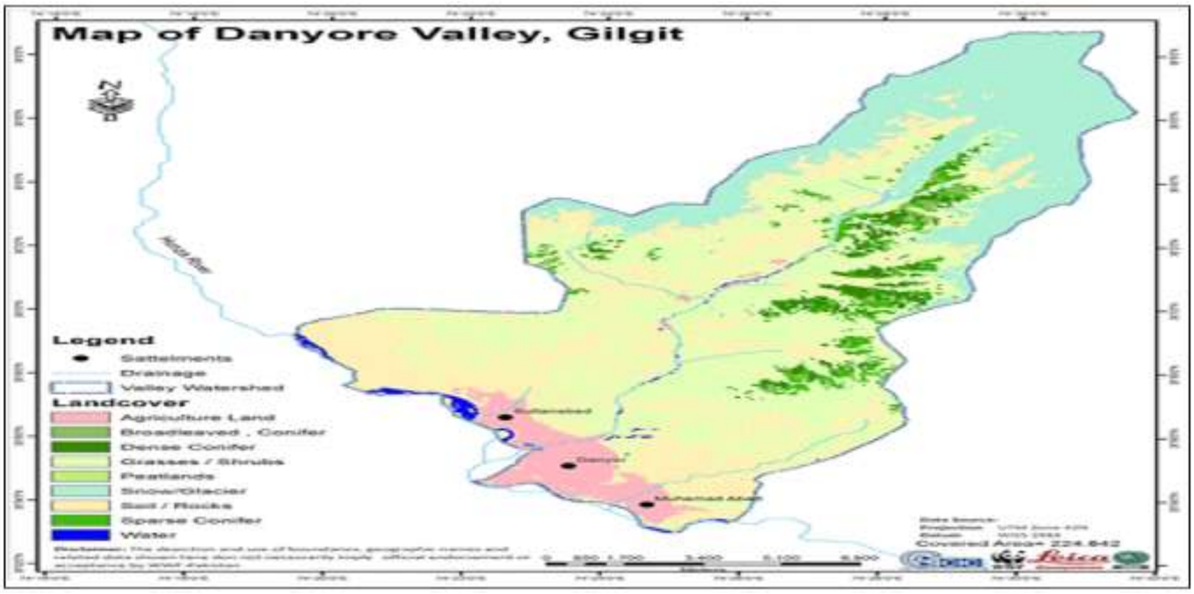

Fig. 1. Map of Danyore Valley, Gilgit-Baltistan.

Altitudinal Gradients

Vegetation parameters *viz.* density, cover and frequency were determined to know the vegetation dynamics of the study area. Data on various vegetation parameters were recorded from selected sites depending on vegetation heterogeneity, slope steepness, area terrain and anthropogenic effects on site. Data was collected from altitudinal variation starting from 1450 meters to 3660 meters, which was divided in to three ranges keeping in view the altitudinal transitions, i.e. from 1450 meters to 2200 meters (level-1), 2200 meters to 2900 meters (level-2) and 2900 meters to 3700 meters (level-3), during late summer and mid-spring seasons.

Line transect method was used for all three parameters density, frequency and cover with square shape quadrats keeping in mind the vegetation heterogeneity, site conditions and for ease in quantitative analysis of parameters at later stages. All parameters for spring season were recorded exactly on the same transects laid initially during summer season survey. Unidentified vegetation samples were collected and brought to laboratory for identification.

Density, Frequency & Cover for Woody Vegetation

Square shaped quadrate with sizes of 100 square meters and with inter-quadrate space or distance of 10 meters over 100 meter transects was kept for trees and shrubs. Transect length was kept 100 meters normally and 50 meters in places with steep and short space terrain for accessibility of work. For trees and shrubs, approximately 135 quadrates were laid in all three altitudinal ranges. A total of 45 quadrates for trees and shrubs with total of 9 transects (3 on each of the sites; plains, slopes and near water points) were laid at each altitudinal level for each season. Density was measured as number of trees in a quadrat; cover was measured by cross-measuring the diameter of tree and then putting the average diameter value in the Area formula given below; While cover for shrubs was measured as length and width. Frequency was measured as specie occurring/ repeating in quadrats.

Density, Frequency & Cover for Non-woody Vegetation

Square shaped quadrats of size 1 meter and with inter-quadrate distance of 10 meter over the same 100 meter transect was followed for grasses, herbs, and forbs; following Hegazy *et al., (*1998*)*. Transect length was kept 100 meters normally and 50 meters in places with steep and short space terrain for accessibility of work. The density, cover and frequency for trees, shrubs, grasses and herbs were measured on same transects at plains, slopes and near water points. Nearly 270 quadrates were laid in all three altitudinal ranges. A total of 90 quadrates for grasses, herbs and forbs with total of 9 transects (3 on each of the sites; plains, slopes and near water points) were laid at each altitudinal level for each season. Density was measured as number of plants for species in a quadrat; cover was measured by ocular observation of the area occupied by different species in quadrats; while frequency was measured as specie occurring/ repeating in quadrats.

For assessing different vegetation parameters, following formulae were used following Hussain, (1989), Hegazy *et al.*, (1998) and (Barbour *et al.*, 1980) for all vegetation types.

Following formula were used for assessing vegetation parameters in field:

$A = \pi r^2$ (For tree cover)

$$\text{Density} = \frac{\text{Number of individuals of species in all quadrates}}{\text{Total area sampled}}$$

$$\text{Relative density \%} = \frac{\text{Number of individuals for a specie}}{\text{Total number of individuals for all species}} \times 100$$

$$\text{Frequency \%} = \frac{\text{Number of quadrates in which specie occurred}}{\text{Total number of quadrates sampled}} \times 100$$

$$\text{Relative frequency \%} = \frac{\text{Frequency value for a particular specie}}{\text{Total frequency values for all species}} \times 100$$

$$\text{Cover \%} = \frac{\text{Area covered by species in a quadrate}}{\text{Total area covered by all species}} \times 100$$

$$\text{Relative Cover \%} = \frac{\text{Total of intercept lengths for a specie}}{\text{Total of intercept lengths for all species}} \times 100$$

Formulae of Density, Frequency and Cover were used for assessing the parameters values for whole quadrats, transect and altitudinal level.

Relative Density, Cover and Frequency formulae were used for individual species at quadrat, transect and altitudinal level. GPS was used to record coordinates for each transects while transect and quadrat measurements were taken using 100 and 20 meters length measuring tapes. Parameters were recorded on formatted record sheets.

Statistical analysis

MS Excel was used for raw data entry and Vegetation parameters were analyzed using Randomized Complete Block Design (RCBD) for ANOVA and means were compared using Least Significant Difference (LSD) following (Steel *et al.* 1997) with help of statistical software; SPSS-16 and Statistix.

Results and discussion

During summer and spring season site surveys, many vegetation species were encountered which were sorted into undergrowth (herbs, grasses, forbs,)and upper growth (shrubs, climbers and trees). During site visits to three different altitudinal levels for seasons of summer and spring, about 71 different species belonging to 41 different families were encountered, out of which 30 were herbs, 14 were trees, 12 were grasses, 12 were shrubs, 2 were forbs and 1 was climber species. *Asteraceae* family was the dominant family with 9 species followed by the family *Poaceae* with 8 different species, mostly with grass species as shown in (Table. 1).

Vegetation Parameters at level-1

At Altitudinal level-1, the maximum site density for grasses was found on water points (17129 plants/ hectare) during summer season (12528 plants/ hectare). The minimum site density for species was found on slope sites (4215 plants/ hectare) during spring season (10210 plants/ hectare).

The water points definitely have more water availability compared to plains and slopes with slopes with least availability in this altitudinal level. For trees and shrubs at level-1, the maximum average density values for sites were found on water points (32 plants/hectare) with 35 plants/ hectare as the highest during summer, while minimum density was found for slopes (5 plants/ hectare) with 53 plants/ hectare as the lowest during spring season. Similarly for the maximum mean density for seasons, it was found during summer season (22 plants/ hectare) and the minimum was found during spring season (17 plants/ hectare).

Table 1. Important vegetation species encountered at Danyore valley.

Scientific name	Common name	Family name	Type
Thymus linearus	Himalayan Thyme	Lamiaceae	Forb
Poabulbosa	Bulbous Bluegrass	Poaceae	Grass
Cynodondactylon	Bermuda grass	Poaceae	Grass
Eragrostispoides	Love grass	Poaceae	Grass
Rumexhastatus	Arrowleaf Dock	Polygonaceae	Grass
Trifolium pretense	Red Clover	Papilionacea	Grass
Saccharumbengalense	Sarkanda	Poaceae	Grass
Imperatacylindrica	Cogon grass	Poaceae	Grass
Setariaviridis	green foxtail grass	Poaceae	Grass
Rubusirritans	Raspberry	Rosaceae	Herb
Plantago major	Broad Leaf Plantain	Plantaginaceae	Herb
Taraxacumofficinale	Dandelion	Asteraceae	Herb
Urticadioica	Stinging nettle	Urticaceae	Herb
Verbascumthapus	Great Mullein	Scrophulariaceae	Herb
Artemisia brevifolium	Wormwood	Asteraceae	Herb
Ephedra gerardiana	Somlata	Ephedraceae	Herb
Geranium pratense	Meadow geranium	Geraniaceae	Herb
Achiellamelifolium	Common Yarrow	Asteraceae	Herb
Adiantumaethiopicum	Common maidenhair fern	Pteridaceae	Herb
Bistortaaffinis	Pink Mountain Fleece flower	Polygonaceae	Herb
Bergenia ciliate	Frilly Bergenia	Saxifragaceae	herb
Cichoriumintybus	Chicory	Asteraceae	Herb
Capparisspinosa	Caper Bush	Capparidaceae	Herb
Sophoramollis	Yellow pea-flower plant	Fabaceae	Herb
Menthalongifolia	Horse Mint	Lamiaceae	Herb
Mentharoyleana	Royle's Mint	Lamiaceae	Herb
Astragalushoffmeri	Yellow leaved Milk-Vetch	Paplionaceae	Herb
Onopordumacanthium	Cotton Thistle	Asteraceae	Herb
Clematis orientalis	Indian clematis	Rananculaceae	Climber
Berberislycium	Indian Barberry	Berberidaceae	Shrub
Hippophaerhamnoides	Seabuckthorne	Elaeagnaceae	Shrub
Rosa webbiana	Web's Rose	Rosaceae	Shrub
Myricariasquamosa	False Tamarisk	Solanaceae	Shrub
Rhammnellagilgitica	Gilgit's wild berry	Rhamnaceae	Shrub
Viburnum spp	Guch, Viburnum	Caprifoliaceae	Shrub
Juniperouscommunis	Dwarf Juniper	Cupressaceae	Shrub
Prunusjacquemontii	Himalayan Bush Cherry	Rosaceae	Shrub
Daphne mucronata	Kashmir Daphne	Thymelaeaceae	Shrub
Tamarixarceuthoides	Tamarisk	Tamaricaceae	Shrub
Betulautilis	Birch	Betulaceae	Tree
Juniperusexcelsa	Cedar, Juniper	Cupressaceae	Tree
Elaeagnusaungustifolia	Russian silver berry	Elaeagnaceae	Tree
Morus alba	White Mulberry	Moraceae	Tree
Piceasmithiana	Spruce	Pinaceae	Tree
Pinuswallichiana	Blue Pine	Pinaceae	Tree
Populusciliata	Himalayan Poplar	Salicaceae	Tree
Salix tetrasperma	Indian Willow	Salicaceae	Tree
Juniperousmacropoda	Pencil cedar	Cupressaceae	Tree
Populusnigra	Black Poplar	Salicaceae	Tree
Salix alba	White willow	Salicaceae	Tree
populus alba	White poplar	Salicaceae	Tree
Rhobiniapseudoacacia	False acacia		Tree
Ailanthus altissima	Tree of heaven	Simaroubaceae	Tree

During summer season, frequency for all vegetation typeson sites was found maximum on water points (882.6 %) and minimum on slope sites (371.5 %). Moreover grasses had more frequency share (421.9 %) compared to trees and shrubs (254.6) during same season. During spring all vegetation types, sites maximum frequency was determined at water points (801.1 %) for and minimum was found on slope sites (304.8 %.).On overall basis frequency and composition share during spring tends more towards grasses with frequency of 366.1 %, compared to trees which had frequency of 239.5 %.

For level-1, the maximum site cover for grasses and herbs was found on water points (28.03 %) during summer, while minimum cover was accounted on slope sites (9.32 %) during spring. Similarly maximum mean season cover was found during summer season (20.08 %), while minimum season cover was determined for spring season with value of 16.16 %. For trees and shrubs at level-1, the maximum mean site density for all seasons was determined for water points with cover of 0.7 % and minimum mean cover was determined for slopes (0.08 %) during all seasons. The plains had mean cover of 0.6 % during all seasons. For seasonal mean cover on different sites it was determined that maximum cover was accounted during summer season (0.6 %), while spring season had minimum mean cover (0.3 %).

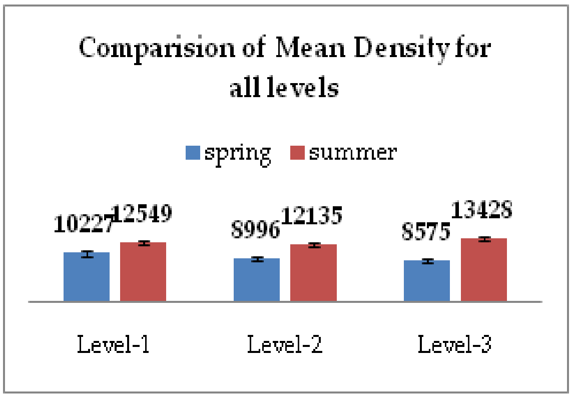

Fig. 2. Differential response of all levels to various seasons for average density (0000 No/ hectare) in Danyore valley.

Vegetation Parameters at level-2

At altitudinal level-2, maximum mean site density for grasses and herbs was found on water points (14436 plants/ hectare) while minimum mean site density was found on slope sites (6563 plants/ hectare) and plains had density of 10616 plants/ hectare. The maximum mean seasonal density was found during summer season (12107 plants/ hectare) and minimum mean seasonal density sites was found during spring season (8969 plants/ hectare). For trees and shrubs, the maximum mean density for sites was revealed on water points (40 plants/ hectare), while minimum sites density was revealed for slope sites (13 plants/ hectare). Likewise for seasonal density, the maximum density was found during summer season (27.66 plants/ hectare) and minimum seasonal density was observed during spring (27.13 plants/ hectare) season.

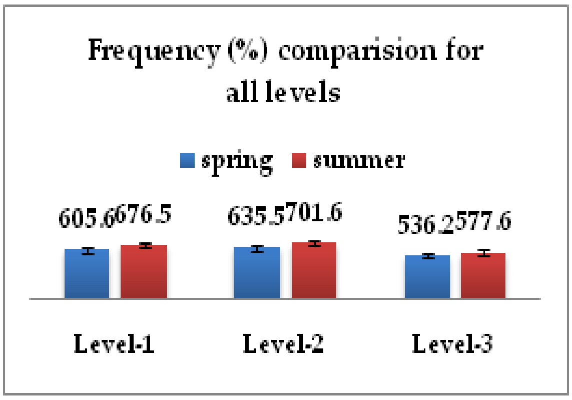

Fig. 3. Comparison for Average Frequency percentage at various altitudinal levels during summer and spring season in Danyore valley.

During summer season, maximum site frequency for all vegetation types was derived on water points (898.2 %) and minimum on slopes (494.4 %). The frequency share was higher from grasses(518.6 %), compared to trees and shrubs which had frequency of 183.0 %. During spring, maximum site frequency for all vegetation types for sites was found on water points (813.2 %) and minimum was found on slopes sites (456.1 %) for all species. species share in frequency was maximum by grasses (474.8 %), compared to trees and shrubs (160.7 %) during spring season.

At level-2, maximum site cover for grasses and herbs during summer was found on water points (22.10 %) and minimum on slope sites (16.53 %), while plains had site cover of 19.70 %.During spring season, maximum site cover was found on water points (16.20 %) and minimum was found on slopes (13.46 %). For mean seasonal cover, maximum mean was found for summer season (19.44 %) and minimum during spring season (14.55 %).

For trees and shrubs, maximum site cover during summer was discovered on water points (6.83 %) and minimum on slopes (2.90 %). Moreover maximum seasonal cover was observed during summer (4.41 %) and minimum for spring season (3.71 %).

Vegetation Parameters at level-3

For grasses and herbs, maximum mean season density was observed during summer season (13398 plants/ hectare) and minimum during spring (8546 plants/ hectare) season. Similarly for mean site density, maximum mean site density was found on water points (14148 plants/ hectare) and minimum mean site density on slope sites (8618 plants/ hectare) with the mean density of 10151 plants/ hectare on plains. For trees and shrubs, maximum mean site density was found on water points (32 plants/ hectare) and minimum mean site density on slope sites (28 plants/ hectare), while plains had mean density of 28 plants/ hectare. Water points had more water available for vegetation as compared to plains and slopes. For mean seasonal density, the maximum was found during summer season (29.9 plants/ hectare), while minimum was found during spring (29.2 plants/ hectare) season.

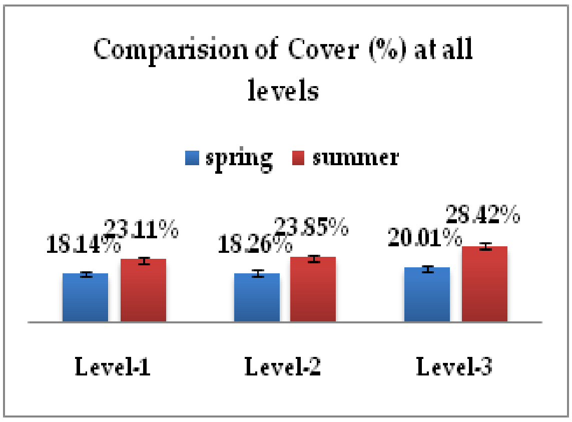

Fig. 4. Differential response of all levels to various Seasons for Cover Percentage.

During summer season, maximum site frequency for all vegetation types was found on water points (647.8 %) and minimum was found on slope sites (499.7 %), while plains had frequency of 585.6 %. Grasses showed more frequency share (320.8 %) compared to trees and shrubs256.8 %.During spring season maximum site frequency for all vegetation types was observed on water points (601.6 %) and minimum on slope sites (478.2 %), while on plains was counted 529.0 %. For frequency share, maximum was given by grasses with 289.8 % frequency, compared to trees and shrubs (246.4 %) during the same season.

For grasses and shrubs at highest altitudinal level, maximum site cover during summer seasons was observed on water points (19.60 %) and minimum was found on slope sites (17.80 %). Plain sites had cover of 18.76 %. Likewise for spring season maximum site cover was found on plain sites (12.96 %).The mean seasonal cover was maximum during summer (18.72 %),and minimum during spring season (10.70 %).

For trees and shrubs, maximum site cover for summer season was found on water points (11.33 %) and minimum on slope sites (8.26 %), while plains had site coverof 9.50 %. Likewise for site cover during spring, maximum was found on water points (10.93 %) while minimum was found on slope sites (8.13 %) and plains had cover of 8.86 %. For mean seasonal cover, maximum was revealed during summer season (9.70 %), while minimum was found during spring season (9.31 %).

According to the graph(Fig. 1) plotted for vegetative density (plants/ hectare) during summer and spring season in Danyore valley at all three altitudinal levels, shows that the mean density at level-1 during summer was 12549 plants/ hectare and during spring was 10227 plants/hectare. Similarly for mean density at level-2, it can be observed that mean density during summer was 12135 plants/ hectare and during spring was 8996 plants/ hectare. Likewise for mean density at level-3, mean density during summer was 13428 plants/ hectare and during spring was 8575 plants/hectare. According to the table for mean density, it can be observed that during summer maximum density was determined at level-3, followed bylevel-1 and minimum at level-2.Maximum density at level-3 was due to good availability of water, with favorable weather conditions and less human and livestock access. Minimum density at level-2 was due to excessive poaching of natural resources, and primarily due to changing of range land to agricultural land on large scale by large number of people living here and rear their livestock.

According to the graph (Fig. 3) plotted for comparison of average frequency at all 3 altitudinal levels during summer and spring, it can be seen that maximum frequency during summer was observed at level-2 (701.6 %) and minimum was observed at level-3 (577.6 %). This is because at level-2, high accumulation of unpalatable species is common and during studying frequency at the level, several herbs and grasses were abundantly repeated in several quadrates. At level-3 frequency was low because of high grazing pressure; floods and landslides due to frequent rain at the level. During spring the trend changes with maximum frequency at level-1 (603.6 %) and again minimum at level-3 (536.2 %). During spring temperature was favorable for vegetation growth and distribution at level-1, while at level-3, temperature was low to initiate growth for several species, except for very few species.

In the graph (fig. 4) drawn for comparison of mean vegetation cover at all three altitudinal levels during summer and spring season in Danyore valley, it can be seen well that during summer season maximum cover was found at level-3 then (28.42 %), at level-2 (23.85 %) and minimum at level-1 (23.11 %). For maximum summer cover for level-3, it is to be noted that the maximum cover share comes from various unpalatable vegetation species; also the area is less prone to anthropogenic impacts for due to difficulty in access. At level-1 with minimum cover it was found that people living here entirely depend on trees, shrubs and other form of vegetation for fuel wood, fodder for livestock and timber for construction extensively throughout the tear. During spring season maximum cover was estimated at level-3 (20.01 %) followed by level-2 (18.26 %) and minimum on level-1 (18.14 %) with the same trend followed at all three altitudinal levels and with the same reasons and effects on vegetation. Level-2 and level-3 are winter rangeland and pastures, populated during summer through autumn season. Some livestock herders use to live during winter season with their livestock at level-2, while level-3 remains almost void of any human or livestock. At level-1 large human population resides on flat plains, by cultivating crops and fruits, along with livestock rearing throughout year. The results obtained for the various parameters on three range sites at three levels were related to findings of Austin *et al*, (1989) and Cop pock, (1994); by which, vegetation dynamics are influenced primarily by environmental variations and secondarily by anthropogenic influences.

Conclusion

Vegetation surveys are necessary, however unfortunately, not a single regional population has been taken under consideration to a complete botanical analysis and the need to do so become more apparent with changing environment and human needs. Plant community of a region is the product of time function, sometimes along with the role of altitude, slope, aspect, latitude, rainfall and humidity
For sites, density, frequency and cover were found maximum at water points at all levels and minimum on slop sites. During summer density, frequency and cover was observed maximum at all levels, and during spring was found minimum during spring season. The species variation from site to site and level to level probably was because of varying the soil type, soil composition, altitudinal differences of levels and sites, soil moisture, varying climate, anthropogenic influences and impacts, livestock rate per level and site and their grazing patterns and preferences.

Recommendations

Management of the entire valley on scientific for natural vegetation and through changing socio-economics of the residing communities lies as core concern in conserving the natural resources from being get vanished entirely from the study area. For this the current study provides a basic understanding of conditions prevailing in the valley and to set objectives and goals for further management of the study area.

Acknowledgement

I must spot that this research would not have been possible without moral and technical support by Dr.

Aamir Saleem, Assistant Professor, Forestry Department, Arid Agriculture University, Rawalpindi; Mr. Saeed Abbas, Conservation Officer, WWF-P, GCIC Gilgit Office who aided their contribution through reviewing the draft of this manuscriptand providing valuable suggestions and content for improvement. I owe gratitude for my co-researchers Yawar Abbas, Fazal Karim and Karim Akbar for their valuable assistance and contributionduring study methodology development, data collection and enumeration, and compilationof results in text form.

References

Ali SI, Qaiser M. 1986. A phytogeographic analysis of the Phanerogams of Pakistan and Kashmir, Proceeding of the Royal Society of Edinburgh **89B,** 89-101.

Austin MP, Heyligers PC. 1989. Vegetation survey design for conservation: gradsect sampling of forest in north-eastern New South Wales. In : C.R.J. Margules(Ed.). Australian developments in conservation evaluation .Biological conservation, **50 (1-4),** 13-32.

Barbour MG, Bruk JH, Pitts WD. 1980. Terrestrial Plant Ecology. The Benjamin/ Cummings publishing company Inc. London. 604 p.

Coppock DL. 1994. The Borona Plateau of Southern Ethiopia: Synthesis of pastoral research, development and change. International livestock Center for Africa, Addis Ababa, Ethiopia **19,** 80-91**.**

Gaur RD. 1999. Flora of the district Garhwal northwest Himalaya (with ethanobotanical notes).Transmedia Publication, Srinagar (Garhwal) India.

Heaney A, Proctor J. 1989. Chemical elements in fitter at a range of altitude on Volcanbarva, costa Rica: Nutrients in Tropical Forest and Savannah Ecosystems. (Ed.): J. Proctor. Blackwell Scientific publications, Oxford.255-271.

Hegazy AK, El-Demerdash MA, Hosni HA. 1998. Vegetation, species diversity and floristic relations along an altitudinal gradient in south-west Saudi Arabia. J. Arid Env. **38,** 3–13.

Hussain F. 1989. Field and laboratory manual of plant ecology. Nation Acad. Higher Educ. UGC, Islamabad, 422 p.

Huston MA. 1994. Biological diversity. Cambridge University Press, Cambridge.

Kharkwal G, Mehrotra P, Rawat YS, Pangtey YPS. 2005. Phytodiversity and growth form in relation to altitudinal gradient in the Central Himalayan (Kumaun) region of India. J. Current Science **89(5),** 873-878.

Shaheen H, Ahmad N, Alam N, Mehmood K, Ullah Z. 2011. Phytodiversity and endemic richness in high altitude Rama Valley, Western Himalayas, Northern Pakistan. J. Medicinal plants research **5(8),** 1489-1493.

Stewart R. 1972. An annotated catalogue of Vascular plants of West- Pakistan and Kashmir. Karachi: Fakhri Printing Press**.**

Tanner EVJ, Vitousek PM, Cuevasv E. 1998. Experimental investigation of nutrient limitation of forest growth on wet tropical mountains. J. Ecol. **79,** 10-22.

Vazquez JAG, Givnish TJ. 1998. Altitudinal gradients in tropical forest composition, structure and diversity in the sierra de Manantlan, Jalisco, Mexico. J. Ecol. **86,** 999-1020.

Whittaker RH, Willis KJ, Field R. 2001. Scale and species richness: towards ageneral, hierarchical theory of species diversity. J. Biogeogr **28,** 453-470.

Hussain A, Ahmed M, Akbar M, Zafar MU, Nazim K, Khan M. 2011.Quantitative community description from Central Karakoram National Park Gilgit-Baltistan, Pakistan. FUUAST, Journal of Biology **1,** 135-143.