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Impact of Grazing Intensity on Phytodiversity of Herbaceous Vegetation at High Altitude Pasturelands of Gulmarg Range, Kashmir Valley (J & K)

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ABSTRACT

The present investigation quantifies the impact of two different grazing regimes (light and moderate) on the vegetation dynamics of high altitude rangelands along different altitudinal gradients of Gulmarg range, Kashmir valley. The phyto-diversity investigation of herbaceous vegetation revealed maximum diversity (H') at site I (1.502) and minimum at site II (0.884) in light grazing sites followed by moderate grazing sites with maximum value at site IV (1.403) and minimum at site VI (0.548). Dominance depicted inverse trend to Shannon diversity index at all sites. Equability index showed high value at site I (0.397) and low at site II (0.355) in light grazing sites whereas it showed reverse trend comparison to the moderate grazing sites with maximum value at site VI (0.340) and minimum at site IV (0.183). Comparatively, richness index overall showed highest values at light grazing sites (average, 2.143) and lowest at moderate grazing sites (average, 0.913). Frequently occurred dominant species at moderate grazing sites (sites I-III) were Plantgao lanceolata, Trifolum pratense, Fragaria nubicola, Rannunculus spp. Stipa siberica, Erigeron Canadensis, Taraxacum officinale, Rumex hastatus, Scandix Brachyactis ciliata and high grazing intensity sites (sites IV-VI) include Taraxacum officinale, Trifolium pratense, Frageria nubicola, Cynodon dactylon, Stipa siberica and Plantago lanceolata. Abundance to frequency (A/F) ratio depicted a trend like contagious>random>regular distribution at six study sites. The study concludes diversity indices showing high trend at moderate grazing sites and low at high grazing intensity sites. Therefore, the study recommends protection of herbaceous vegetation from further degradation by grazing activities at selected study sites.

Key words: *Herbaceous, Grazing, Rangelands, Altitude, Species.*

INTRODUCTION

Natural and human disturbances are both considered as major drivers of species diversity in plant communities. In general, frequency and magnitude of disturbance are key factors for changes in species diversity[1-4]. The relationship between disturbance and species diversity also depends on the spatial scale[5-7].

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Under extensive disturbance species diversity normally declines, but moderate disturbance can enhance or reduce it depending on the spatial scale and types of species[8, 9, 7]. Hence, understanding the relationship between disturbance and species diversity is fundamental during the setting of conservation policy.

Humans, like other organisms, modify their environment through land use and land cover change, via introduction of alien species, industrialization and alteration of biogeochemical cycles. The degree to which humans are capable of modifying their environment is unmatched by any other living organism on earth. Natural disturbance and human induced impacts have caused a significant change in biodiversity especially in regions which are under the process of development[10] and also responsible for greater diversity of plant and animals in natural habitats. Human disturbances, particularly from the overexploitation of biological resources, generally have negative impacts on species diversity at a global scale[11,12]. However, research shows that less severely disturbed forests (intermediate disturbance) provide optimum environments for enhancement of α-diversity[13, 1, 14-16]. In such forests, openings of the canopy allow sunlight to reach the forest floor. Environmental heterogeneity is increased under such conditions through the development of microhabitats with a number of patches, gaps, and edges. Concomitantly, physical properties of the environment (light, temperature, soil moisture, and nutrient resources) are also improved which can provide suitable habitats for new species to colonize.

The information about floristic composition of an area is said to be a perquisite for any phyto-geographical, ecological, and management activities. Floristic composition reflects the diversity of vegetation of an area and can be affected by many factors such as overgrazing, soil deterioration, deforestation and dependence of local people/pastoralists on plants. The identification of local plants along with description of an area is essential as it can provide particular species of the local area, growing season, species hardness, any new species establishing in the area and the effect of climatic conditions like over-grazing and drought on vegetation there[17]. Floristic studies are often the only source for botanical information about a specific area and may provide a suitable starting point for more comprehensive studies[18].

Grazing land is an important component of global land use. Roughly 50 percent of the earth’s terrestrial surface is grazed by herbivores. Grazing animals influence species composition, change in biomass and distribution of biodiversity. [19]Observed that overgrazing reduces the ground cover vegetation, plant diversity and productivity. Trampling and crushing by humans and animals are the common physical disturbances. Physio-chemical disturbance is widely recognized as a primary influence on plant community composition and spread of invasive exotics[20]. Overgrazing has a number of negative impacts, including increases in undesirable vegetation[21] decreases in biomass and loss of vegetation cover[22, 23] and reduced species diversity[24]. Grazing has been generally considered to have negative effects on plant fitness. Herbivores cause structural damages, remove plant biomass, decreasing the leaf area available for photosynthesis[25, 26]. However, the effects of herbivores on plants can be positive as well. Grazing prohibition is the most commonly applied management tool when seeking to reverse grassland degradation[27, 28].
To effectively assess and predict the effects of both grazing and overgrazing on vegetation, data on plant cover, density, and species richness, other diversity parameters and population distribution were assessed. An attempt in this context was made to assess the impact of various grazing intensity on plant species diversity in high altitude pasture lands of Gulmarg range, Kashmir Valley.

MATERIALS AND METHODS

Study area and Site

The study was conducted at six study sites of different altitudinal gradient in Gulmarg range of Kashmir Valley. The description of sites is given as under:

Site I (Tangmarg protected ,TP) and site IV (Tangmarg degraded, TD): The sites are about 39 km away from Srinagar, the summer capital of J & K state having co-ordinates of $34^{0.}$03N and $74^{0.}$25E, elevation 2156m amsl.

Site II (Babareshi protected, BP) and site V(Babareshi degraded, BD): This site lies in between Gulmarg and Tangmarg range having co-ordinates of 34^{0}.03N and 74^{0}.24E with an average elevation of 2272m amsl.

Site III (Gulmarg protected, GP) and site VI (Gulmarg degraded, GD): Gulmarg is about 46 km away from Srinagar having co-ordinates of 34.05°N 74.38°E, with an average elevation of 2,690m amsl.

Data analysis

The vegetation data recorded was quantitatively analysed for density, frequency and abundance following[29].The relative values of these indices were determined as per [30]. These values were summed up to get importance value index (IVI) of individual species[31]. The ratio of abundance to frequency (A/F) for different species was determined for eliciting the distribution pattern. This ratio has been indicated as regular (<0.025), random (0.025 to 0.05) and contagious distribution (>0.05)[32].

Plant diversity in the six study sites were evaluated using the following indices;

Measurement of diversity

The diversity index was calculated by using the Shannon–Wiener diversity index[33]

Diversity index = $H = -\sum Pi \ In \ Pi$

Where $Pi = S / N$

S = number of individuals of one species

N = total number of all individuals in the sample

In = logarithm to base e

Simpson Index[34]

$$D = \Sigma \ pi^2$$

Measurement of species richness

Margalef's index was used as a simple measure of species richness[35]

Margalef's index = $(S - 1) / In \ N$

S = total number of species

N = total number of individuals in the sample

In = natural logarithm

Measurement of evenness

For calculating the evenness of species, the Pielou's Evenness Index (e) was used[36]

$e = H / In \ S$

H = Shannon–Wiener diversity index

S = total number of species in the sample

RESULTS AND DISCUSSION

During the study period the number of species enumerated at light grazing sites (site I, 14; site II, 12; site III, 15) and moderate grazed site showed number of species occurrence viz., site IV, 6; site V, 8 and site VI, 5 respectively (**Figure, 1**). However, highly dominant species based on IVI are presented in Figure **2-7** and describing in decreasing order at site I-III (site I, *Trifolium pratense*, 39.17; *Trifolium repens*, 37.78; *Frageria nubicola*, 36.99; *Plantago lanceolata*, 27.35; and *Poa spp*. 23.43; Site, II, *Frageria nubicola*, 48.73; *Stipa siberica*, 48.08; *Erigerion Canadensis*, 47.06; *Trifolium pratense*, 38.22; *Trifolium repens*, 26.31 and *Ranunculus spp*. 25.19; Site III, *Rumex hastatus*, 36.71; *Stipa siberica* / *Trifolium pratense* (30.18); *Scandix spp*., 28.91; *Hypericum perforatum*, 25.84; *Ranunculus spp*. (24.83); *Brachyactis ciliata*, 27.9 and *Frageria nubicola* 20.23). At moderate grazing site (site IV) dominant species were *Plantago lanceolata*, 101.07; *Stipa siberica*, 58.17; *Trifolium pratense* 56.58; *Cynodon dactylo*n, 34.40 and *Mentha spp*. 29.65; site V, *Frageria nubicola*, 121.73; *Cynodon dactylon* 63.79; *Eigeron Canadensis*, 27.33; *Ranunculus spp*./*Rumex hastaus*, 25.34 and at site V, *Cynodon dactylon*, 118.12; *Taraxacum officinale*, 66.95; *Trifolium pratense*,60.52 and *Plantago lanceolata*, 48.11; site VI, *Plantago lanceolata*, 101.07; *Stipa siberica*, 58.17, *Trifolium pratense*, 56.58 and *Cynodon dactylon*, 34.40). The species dominants changed with changing seasons. [37]have showed the occurrence of temporal dynamics in weed communities on the scale of seasonal changes. In rainy season grass species are dominated and found throughout the year. The ecological conditions appear to be further complicated by transfer and dispersal of the propagule by human activities i.e. grazing and random biotic movement. For grazing land community, topography, edaphic factors and disturbance had been reported to produce variation in compositional structure of vegetation[38]. High livestock grazing pressure negatively affects the environment, but its effect on plant communities is highly variable from one site to another[39, 40]. It has been shown that such changes to vegetative and reproductive output have the potential to alter species population dynamics and potentially change the vegetation community[41-47]. Monitoring of grazing impacts is necessary for rangeland management to ensure that it is used sustainably[48] and are considered as useful environmental indicators of environmental pressures[49, 50].

Many studies worldwide have shown that chronic and intensive grazing of rangelands can be detrimental to plant and plant communities, because it removes leaf area that is necessary to absorb photosynthetically active radiation and convert it to chemical energy[51-54]. The negative impact of continuous grazing on species composition will continue to increase as long as no change in management has taken place.

The various diversity indices are presented in figure 8 & 9. The perusal of the data at light intensity grazing sites revealed diversity index (H') maximum at site I (1.502) and minimum at site II (0.884). Moderate grazing sites showed highest value at site IV (1.403) and lowest at site VI (0.548). Substantially among light intensity and moderate grazing sites highest species diversity was recorded (site I, 1.502; IV, 1.403). In agreement with these results[55] and[56] reported that grazing by domestic livestock is commonly associated with changes in species composition in rangelands throughout the world.

Evenness index at light grazing sites recorded highest at site I (0.397) and lowest at site II (0.355). From this study, it is apparent that species diversity of a site is not a constant feature; it varied with site to site and impact of intensity level. This indicated that developmental stage of community is complicated by disturbance factors and their intensity. Disturbance however, complicated the relationship between environment and vegetation. This could be attributed to the diverse propagule transfer as well as relatively higher soil organic carbon and higher soil moisture at this site, allowing multiple species co-existence[57].

An inherent difference in site characteristics also influences the disturbance–diversity relationships[5]. This supports the argument that a considerable opening of forest canopy (intermediate disturbance) enhances plant diversity[1, 2] and can maintain optimal habitat conditions for plant species conservation on the local scale. Such results are with confirmation to many previous studies which supported that under heavy grazing decreases biodiversity[21, 58] due to the dominance of certain species. Few of the species like *Cynodon dactylon* are favoured by grazing as a result their abundance and cover increases, while others are not and reduce in number and cover[59]. All the tested diversity and evenness indices of the woody layer vegetation reached their maximum values under light grazing intensity[65]. Additionally, dominance was significantly reduced under this grazing intensity. Species richness which indicates both number of species and their numerical strength revealed slightly higher value at light grazed site (average, 2.014). Richness index at light grazing site depicted a variation between 2.390 (site I) to 1.710 (site II) and 1.097 (site V) to 0.629 site (VI) (Figure, 8 & 9). The dynamics of vegetation in a rangeland/high altitude are determined by array of factors which include the frequency and intensity, grazing regime, climatic fluctuations and to some extent the soil characteristics. In the present investigation species diversity (H') on average showed high trend (average, 1.149) at light grazing sites (site I-III) and lowest value (average, 0.846) compared to moderate grazing sites (sites IV-VI).

Generally, when moderate grazing intensity is applied, plant diversity tends to increase as dominant species are reduced while the less competitive ones are increased[60]. Additionally, [61] supported that different grazing intensity effects similar land uses could lead to floristic differentiation of the plant community due to selective pressure on plant species mainly by browsing strategies and foraging behaviour[62, 63]. Plant diversity depicted higher trend in intermediate human disturbance (IH) compared to other land uses has already studied by [64]. Simpson dominance index was inversely related to diversity index (H') at all sites (0.158, site II to 0.090 site III) and (0.481 site VI to 0.279 site IV). Inverse relationship in Shanon diversity index and Simpson index in grazing intensity sites were also reported by [65-69]. Under light grazing intensity, Simpson diversity index has shown less reduction due to dominance of few competitive species[70] which is in concurrent to the findings of present study. Some species dominates the study area throughout the study period (*Fragaria nubicola*, *Taraxacum officinale*, *Trifolium pratense*, *Plantago lanceolata*, *Cynodon dactylon*, *Rumex hastatus* and *Erigeron canadensis*) evidently due to wide ecological amplitude and under prevailing climatic conditions. Concurrently these species indicate that habitat modified due to persisting disturbance (Grazing and anthropogenic pressure) which creates plate form for the onset of biological invasion by such species[71]. Moreover, the disturbed area supported more herbaceous vegetation as compared to undisturbed area because of reduction in species competition for space and resource during different grazing intensities. [72] and [73] reported increase in plant diversity at disturbed ecosystems. Further more, [1] and [74] were also of the same opinion in diversity index assessment. However, studies conducted earlier in disturbed areas shows reduction in species diversity by most plant communities[75]. Their findings are well in support to the present investigation of diversity index H' (avg.1.149, site I-III and avg. 0.846, site IV-VI). Richness index on average followed similar trend with maximum value (2.143) at light grazed (site I-II) to (0.913) at moderate grazed sites (IV-VI). However, Evenness index on an average showed slightly higher values at moderately grazed site (0.617) compared to light grazed sites (0.381). This fact confirms the moderate grazing hypothesis[76, 58, 77] that light and moderate grazing results in an increase of biodiversity, whereas at low grazing pressures or at absence of grazing some species become dominant, hence the reduced diversity[70].

Moreover, the work on biodiversity indicated that diversity tend to be highest under moderate grazing intensity pressure[78]which further authenticates the level of diversity trend of this study. Further, research has proved the depending on seasons, the density of grazers influence both species diversity, spatial heterogeneity and the vegetation structure[79, 80]. Connell *et al.*[1] and Decocq *et al.*[74] reported highest diversity of species in intermediate disturbed ecosystem or when grazing intensity is accelerated. Many studies emphases moderate level of grazing can promote species diversity [81,82]. The results of evenness diversity (site I, 0.397; site II, 0.355) recorded in the present study are supported by Lalfakawma *et al.*[83] who concluded that undisturbed site obtained high evenness that of disturbed site (site II). The studies conducted earlier by [84] were in parallel to the present study. Further more, lower value of species evenness is because of distribution of individual species in time and space due to influence of seasonal variation at this site[67], which could probably be due to patches of unpalatable species left over by grazing animals after consuming palatable ones. Evenness index on an average showed slightly higher values at moderately grazed site (0.617) compared to light grazed sites (0.381). Favourable results of evenness index in comparison to this study were also obtained by Shameem *et al.*[65], Shameem *et al.*[66], El-Khouly *et al.*[85] reported evenness values about grazed and un-grazed sites parallel to present study.

Abundance to frequency (A/F) occurrence of species is depicted in Figure **10-16**. It shows most of the species followed contagious >random>regular distribution in species appearance pattern at six study sites (**Figure, 10**). Contagious pattern showed higher trend in species distribution (100%) at site VI followed by site II (91.66%), site III (86.666) and site IV (83.33%). Random distribution of species pattern showed higher trend at site I (42.85%) followed by site V (28.57%) and site IV (16.66%). However, no species showed random distribution at site VI. Such pattern of species distribution in herb layer vegetation were also reported by Shameem *et al.*[65], Shameem *et al.*[66] as depicted by (**Figure, 10**). The pattern of distribution depends both on physico-chemical natures of the environment as well as on the biological peculiarities of the organisms themselves. Dominance of contagious distribution may be due to the fact that majority of the species reproduces vegetatively in addition to sexuality. However, the investigation indicated that contagious distribution obtained with high trend was due to the multitude factors and the vegetation reproduction may not be only reason[88, 89]. The nature of plant community at a place is determined by the species that grow and develop in such environment[86]. Difference in the species composition from site to site is mostly due to micro environmental changes[87].

Similarity Index

The similarity index recorded at different sites is presented in Figure-**17-21**. Maximum similarity of species (80%) was observed between sites II (BP) vs. site V (BD) followed by site III (GP) vs. site VI (GD) 50% and minimum 20% between sites I (TP) and site IV (TD). Comparing protected vs. protected sites similarity was highest observed between site I (TP) vs. site II (BP) 46% and lowest 41.37% between site I (TP) vs. site III (GP). However, degraded sites showed highest similarity (57.14%) between site IV (TD) vs. site V (BD) and lowest (33.33%) between site VI (GD) vs. site V (BD). Higher similarity of vegetation (80%) that grew in favorable conditions of moisture availability in rainy season and winter season of the site indicates commonness of ecological opportunists. Close contesting species for top dominance rank indicated a complex situation of seral stages interrupted by disturbance dynamics that probably caused the variability of species composition. The ecological conditions appear to be further complicated by transfer and dispersal of the propagule by human activities i.e. grazing and random biotic movement. For grazing land community, topography, edaphic factors and disturbance had been reported to produce variation in compositional structure of vegetation[38]. Few species dominated the study area (*Cynodon dactylon, Erigeron Canadensis, Frageria nubicola, Plantago lanceolata, Rumex hastatus Taraxacum officinale and Trifolium pratense,*), due to their wide ecological amplitude under the prevailing climatic conditions. Therefore, the results point out that habitats modified due to persisting disturbance (grazing and anthropogenic pressure) and creates platform for the onset of biological invasion by such species[71].

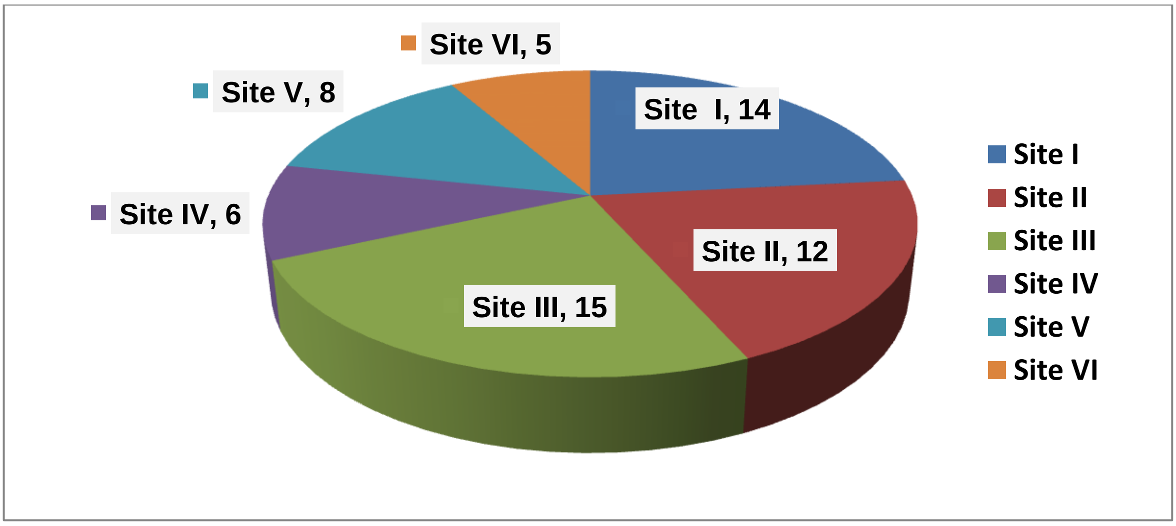

Fig. 1: Number of species recorded during the study period at different sites

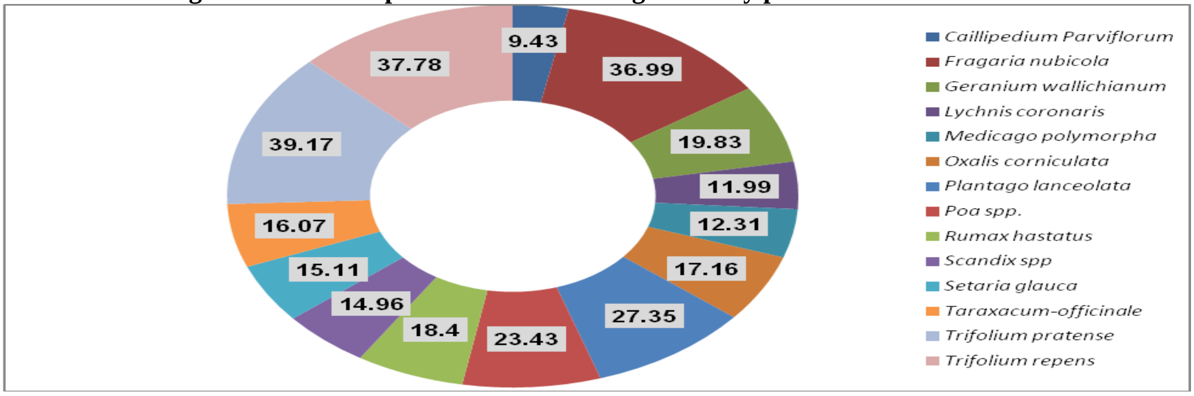

Fig. 2: Highly dominant herbaceous plant species recorded at site I (TP)

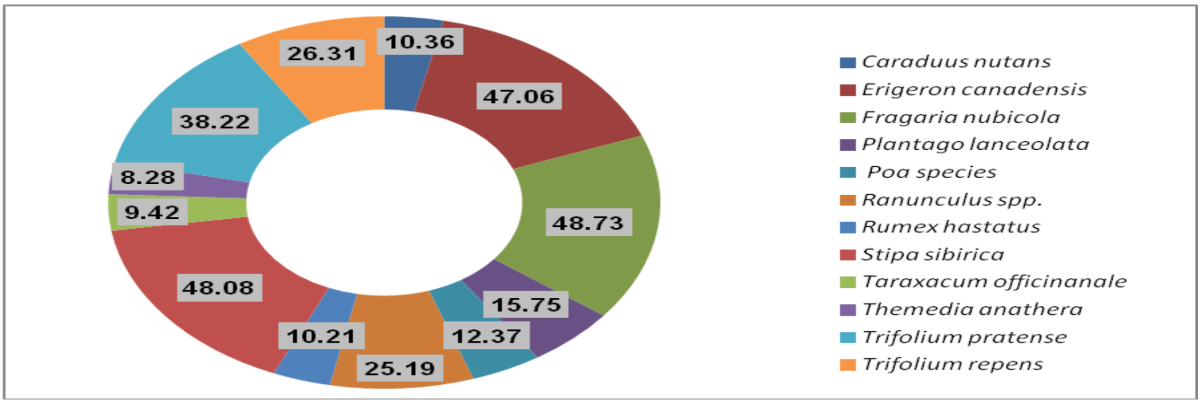

Fig. 3: Highly dominant herbaceous plant species based on IVI values recorded at site II (BP)

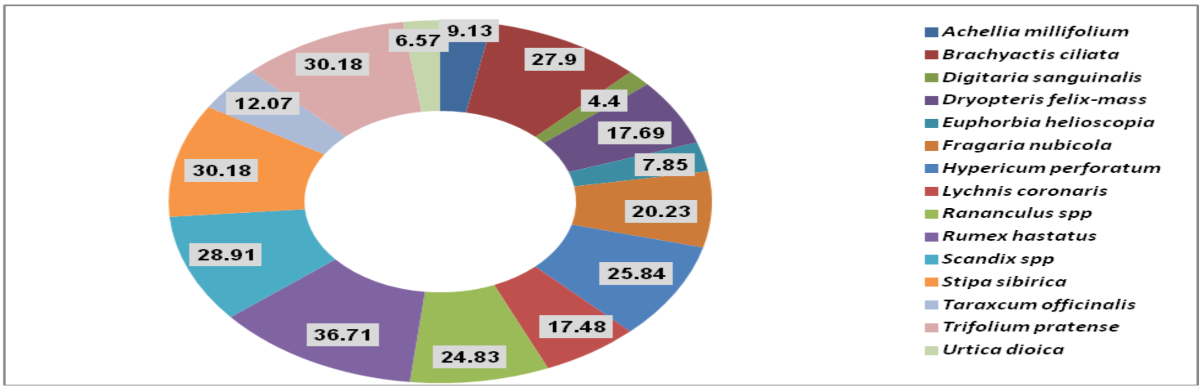

Fig. 4: Highly dominant herbaceous plant species recorded at site III (GP)

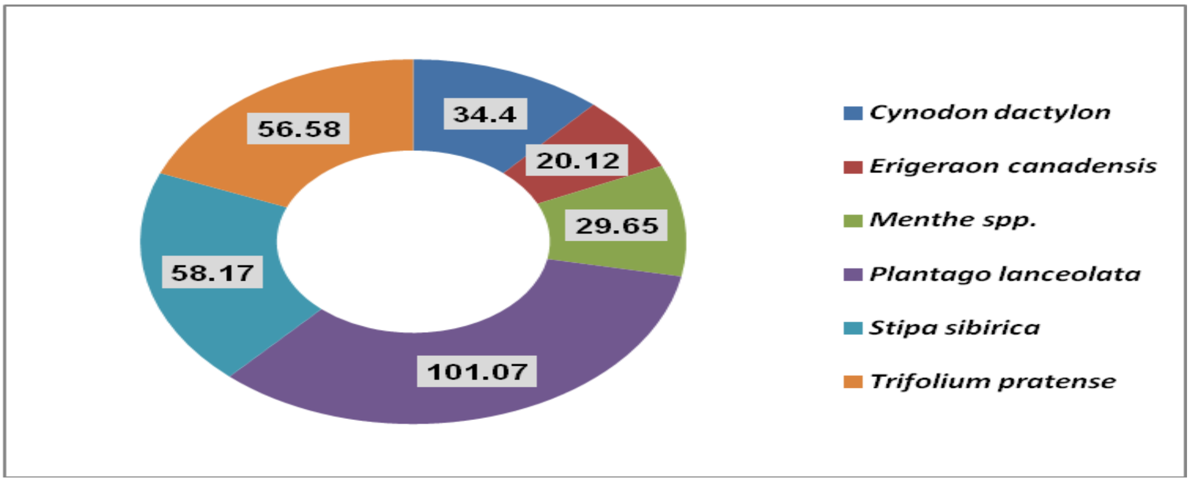

Fig. 5: Highly dominant herbaceous plant species based on IVI recorded at site IV (TD)

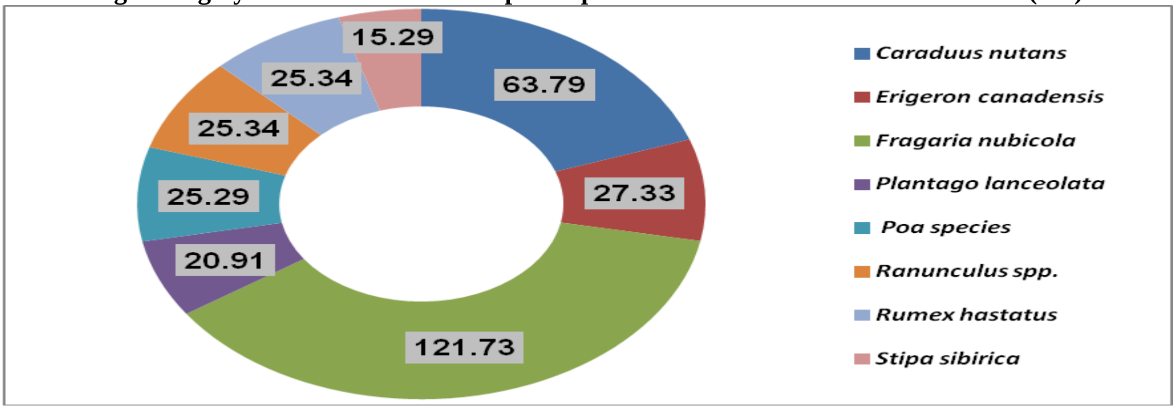

Fig. 6: Highly dominant herbaceous plant species based on IVI values recorded at site V (BD)

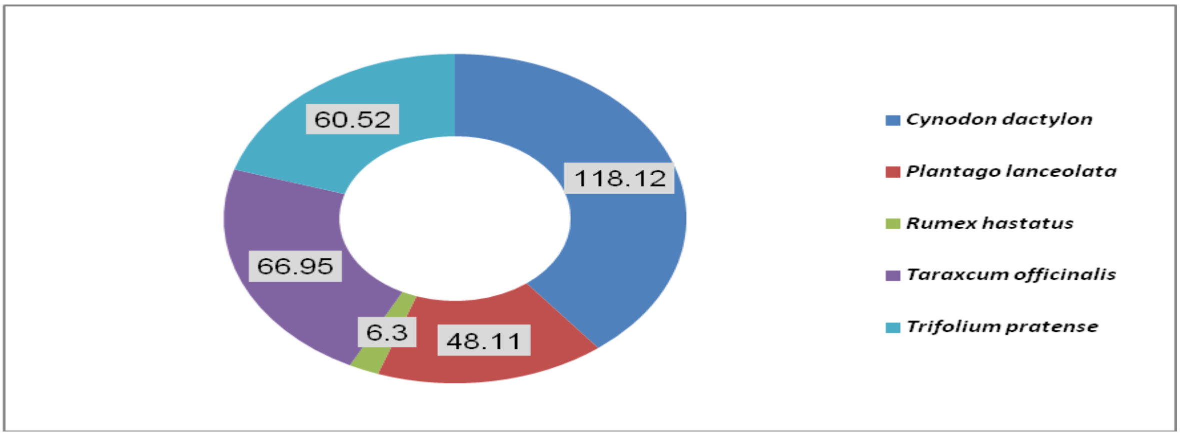

Fig. 7: Highly dominant herbaceous plant species based on IVI values recorded at site VI (GD)

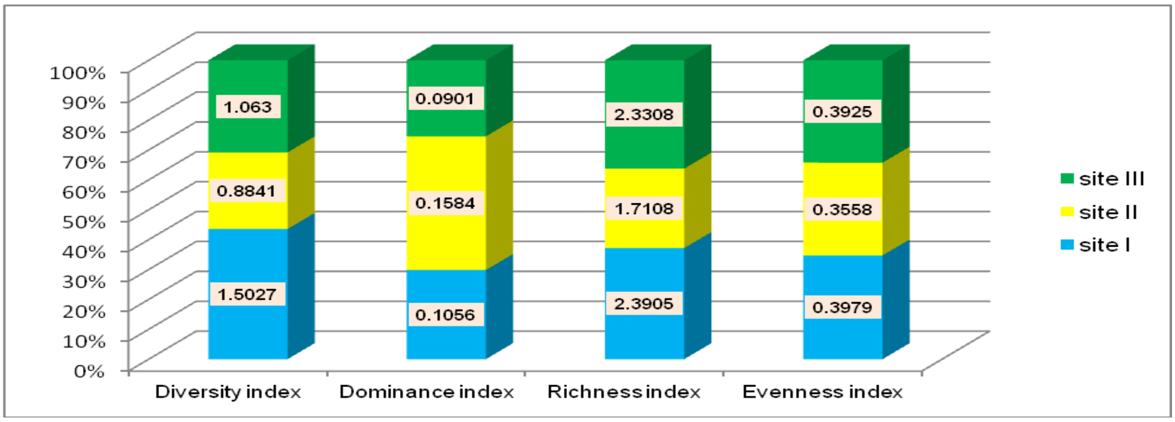

Fig. 8: Diversity estimates of the herbaceous plant species at site I, II and site III

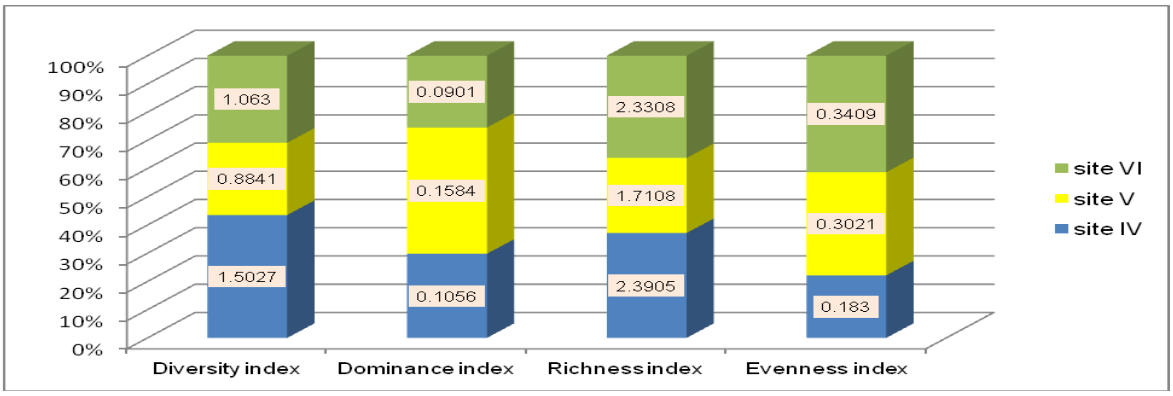

Fig. 9: Diversity estimates of the herbaceous plant species at site IV, V and site VI

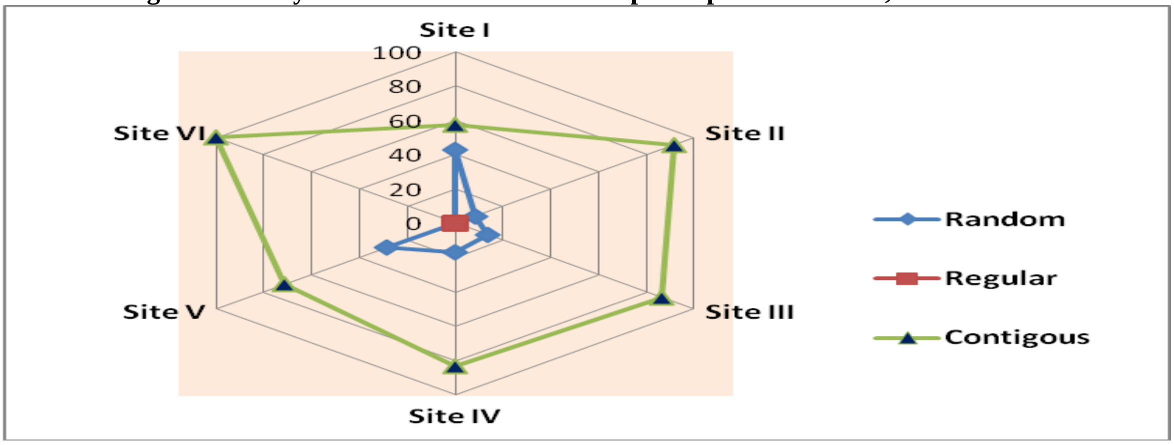

Fig. 10: Distribution pattern (%) of herbaceous plant species recorded at six study sites

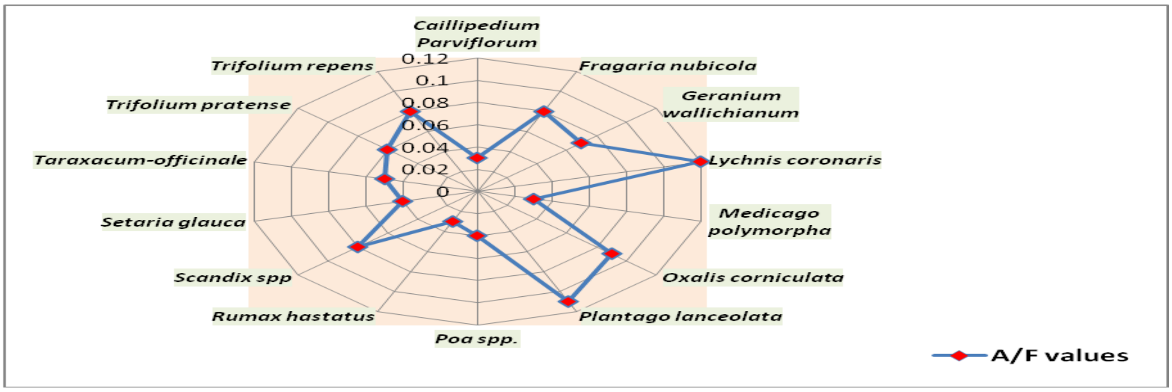

Fig. 11: A/F values of species recorded at site I (TP)

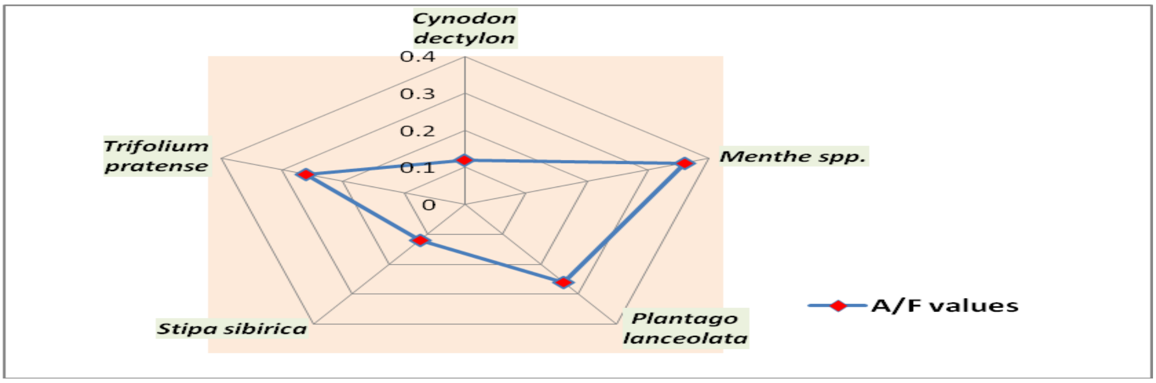

Fig. 12: A/F values of species recorded at site I (TD)

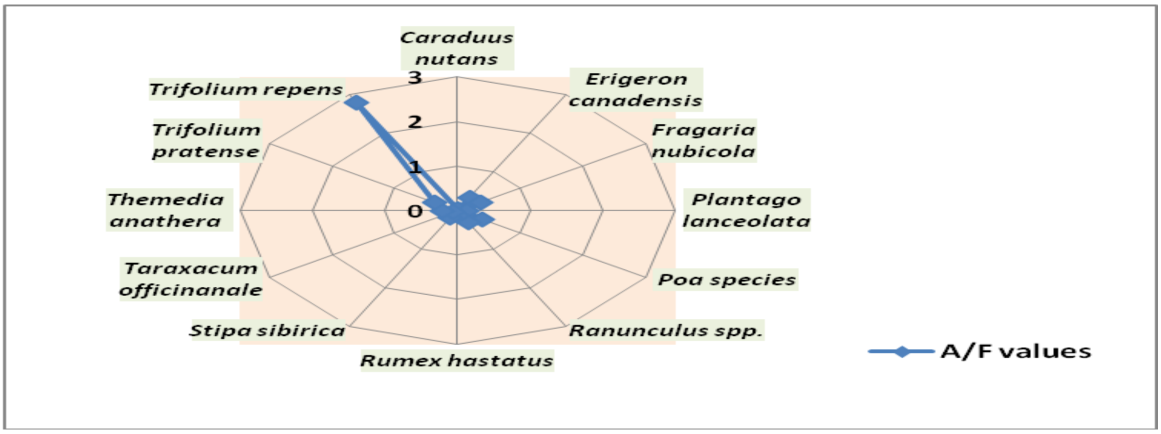

Fig. 13: A/F values of species recorded at site I (PB)

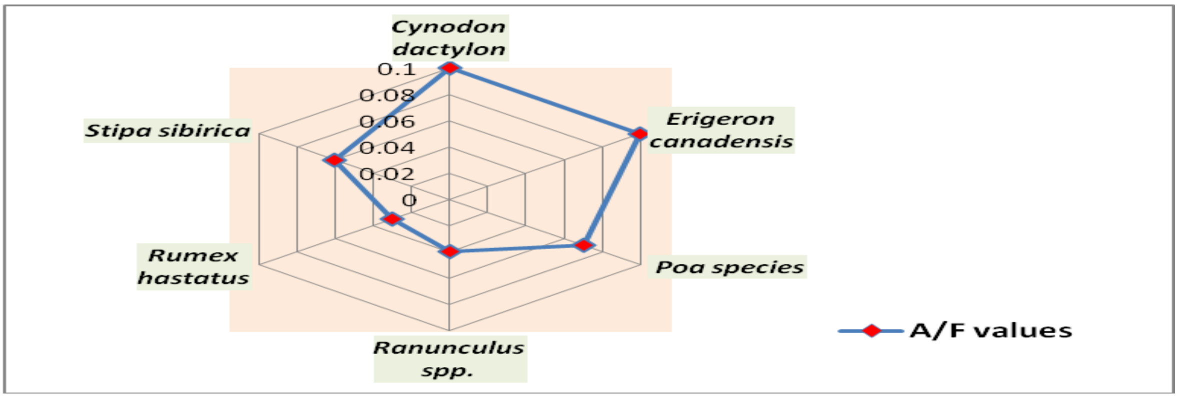

Fig. 14: A/F values of species recorded at site I (BD)

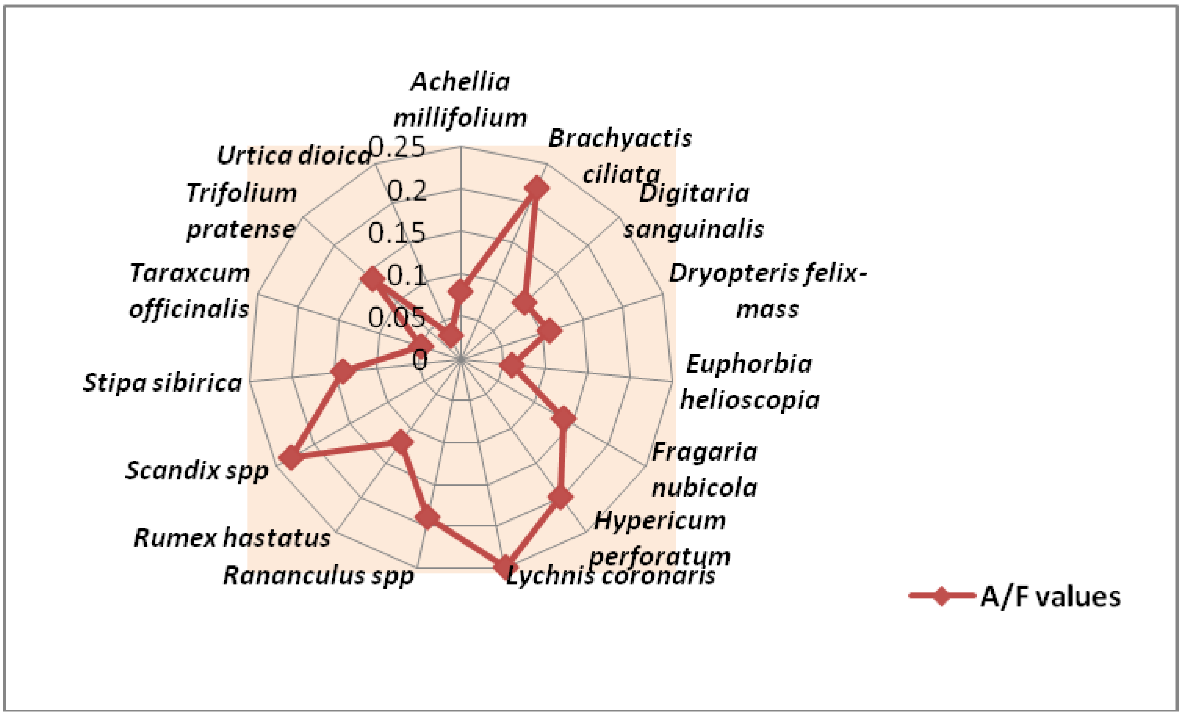

Fig. 15: A/F values of species recorded at site I (GP)

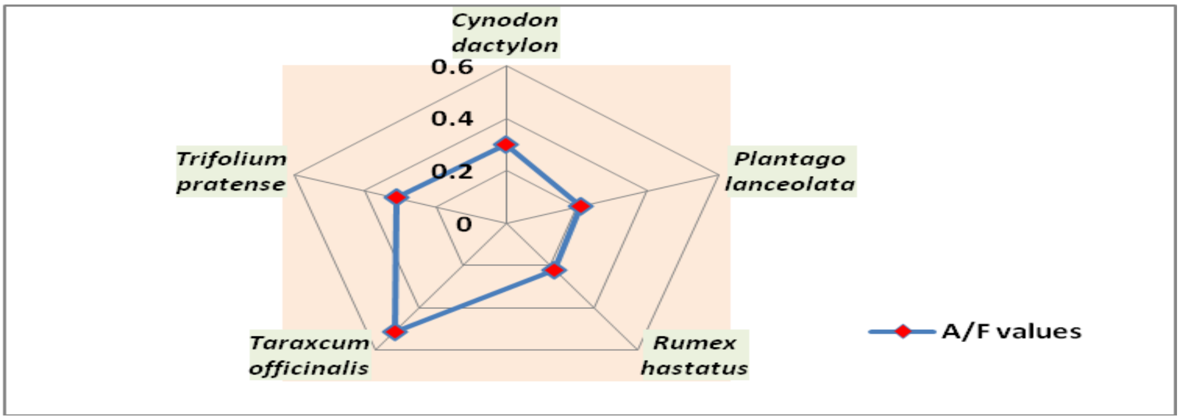

Fig. 16: A/F values of species recorded at site I (GD)

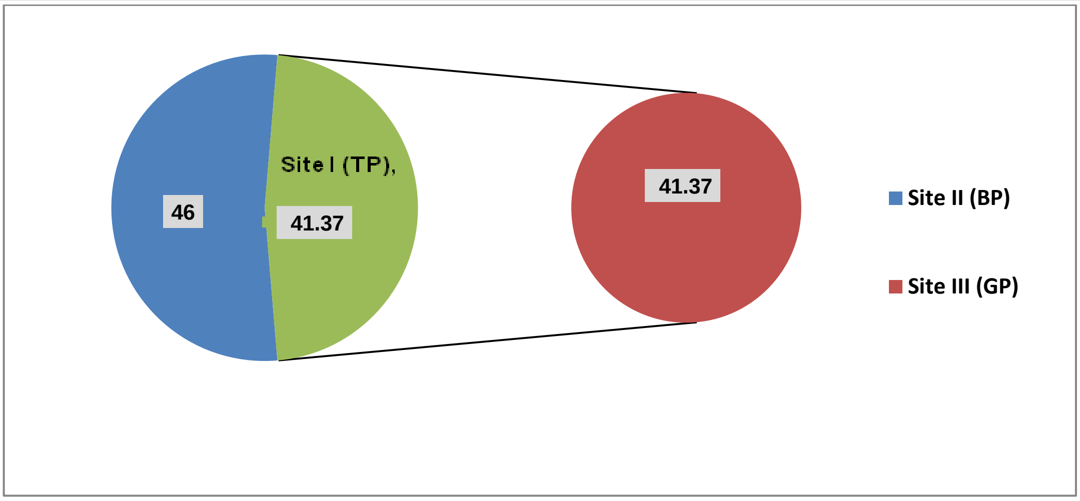

Fig. 17: Species similarity betewwn Site I (TP), Site II (BP) Vs Site II (BP) and Site III (GP)

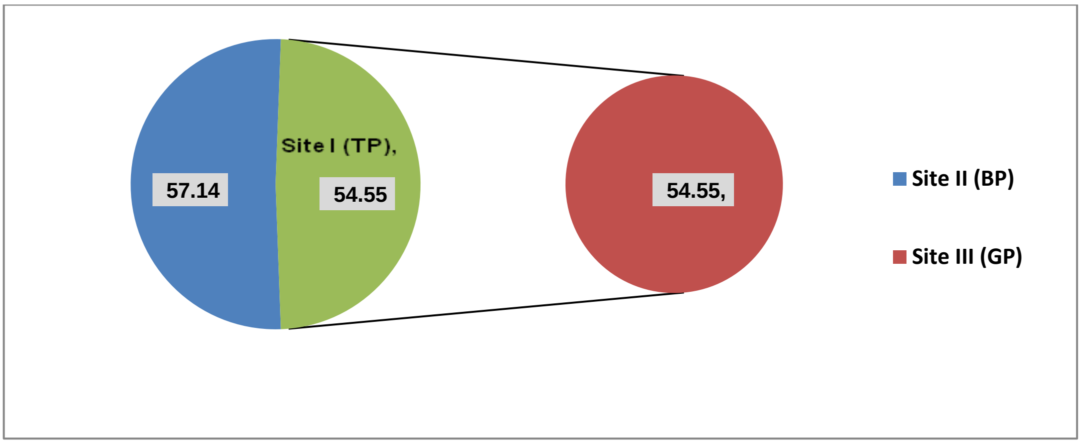

Fig. 18: Species similarity between Site I (TP), Site II (BP) Vs Site II (BP) and Site III (GP)

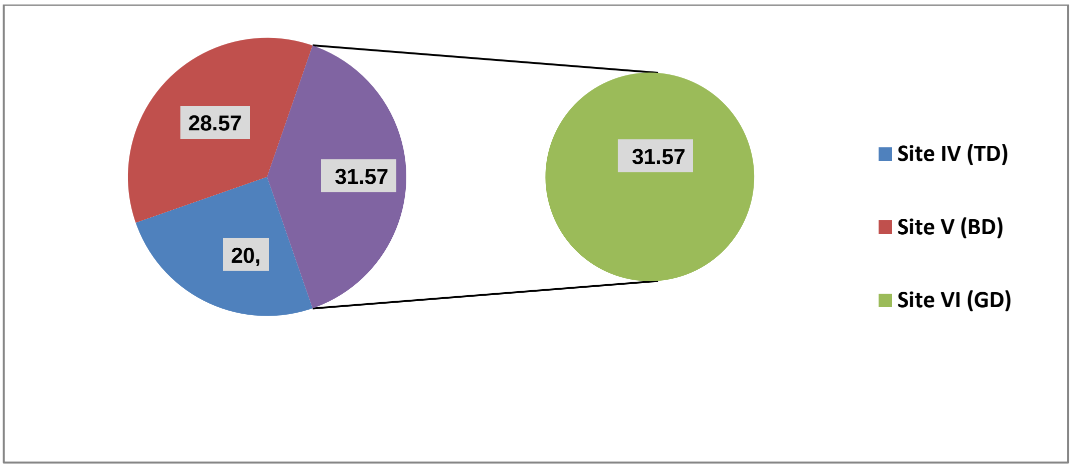

Fig. 19: Species Similiarity between Site I (TP) Vs Site IV (TD),Site V (BD) and Site VI (GD)

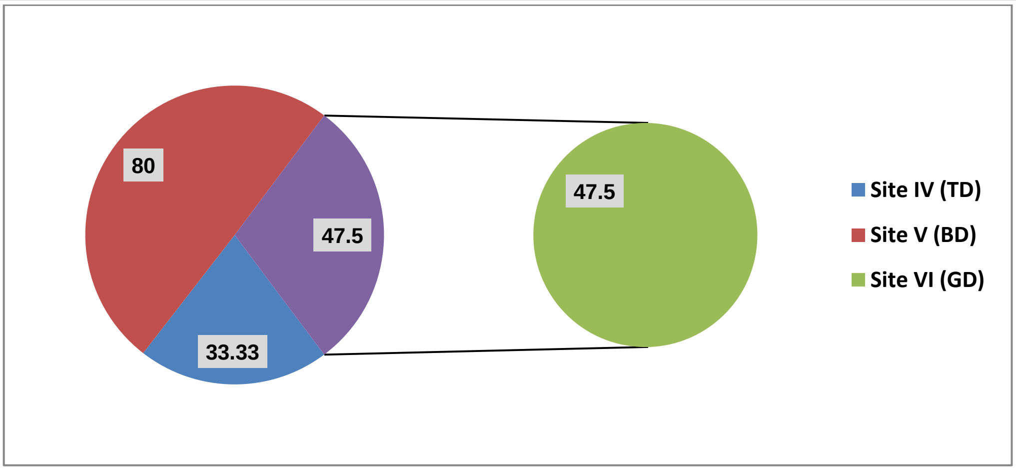

Fig. 20: Species Similiarity between Site II (BP) Vs Site IV (TD), Site V (BD) and Site VI (GD)

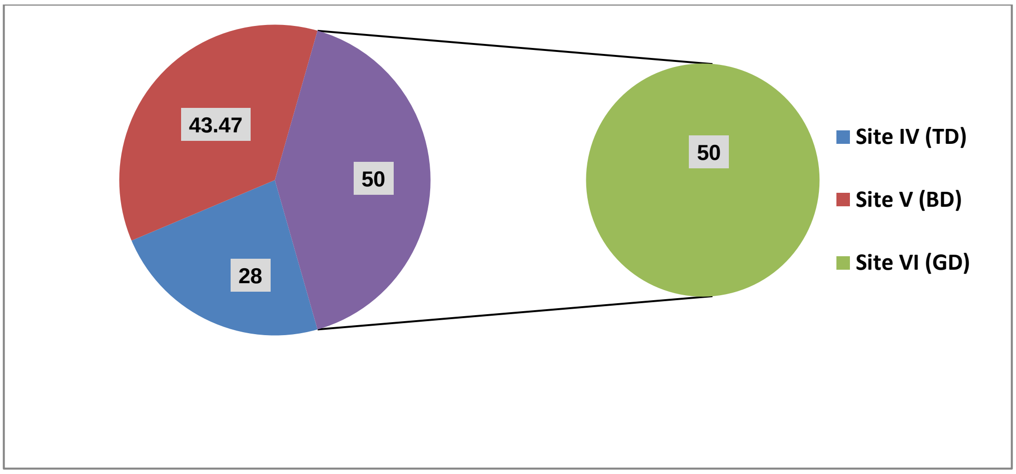

Fig. 21: Species Similiarity between Site III (GP) Vs Site IV (TD), Site V (BD) and Site VI (GD)

CONCLUSION

Regular monitoring of livestock grazing at seasonal level and human disturbance particularly during peak tourist season in the study area are urgently required to protect the effected plant species diversity. It is urgently required to explore more grazing area for seasonal grazing of livestock as substitute to the already grazed sites which needs to be protected for a minimum period of 5 years. However, increasing stress due to human activities particularly for fuel fodder collection, harvesting of medicinal herbs, burning of ground vegetation and livestock grazing requires sustainable control measures in the study area. It is further recommended that species with lower importance value index (IVI) need priority measures for protection and those with higher importance value index (IVI) need monitoring effort in order to maintain different diversity indices in the selected sites during different seasons.

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REFERENCES

1. Connell, J.H., Diversity in tropical rain forests and coral reefs.11 *Science*. **199 (4335):** 1302–1310(1978).
2. Huston, M., A general hypothesis of species diversity. *American Naturalist,* **113(1):** 81-101(1979).
3. Sousa W. P., Disturbance in marine intertidal boulder fields: the nonequilibrium maintenance of species

diversity. *Ecology,* **60(6):** 1225–1239(1979).
4. Petraitis, P.S., Latham, R.L., Niesenbaum, R.A., The maintenance of species diversity by disturbance. *Quarterly Review of Biology*, **64:** 393–418 (1989).
5. Denslow, J.S., Gap partitioning among tropical rainforest trees. *Biotropica,* **12(2):** 47–55(1980**)**.
6. Hill, J. K. and Hamer, K. C., Determining impacts of habitat modification on diversity of tropical forest fauna: the importance of spatial scale. *J. Appl. Ecol*., **41(4):** 744–754 (2004).
7. Dumbrell, A. J, Clark, E. J., Frost, G. A., Randell, T.E., Pitchford, J. W., Hill, J.K., Changes in species diversity following habitat disturbance are dependent on spatial scale: theoretical and empirical evidence. *J. Appl. Ecol*. **45(5):** 1531–1539(2008).
8. Chaneton E. J., Facelli J. M., Disturbance effects on plant community diversity: spatial scales and dominance hierarchies, *Vegetatio* **93:** 143-155 (1991).
9. Hamer, K. C. and Hill, J. K.,. Scale-dependent effects of habitat disturbance on species richness in tropical forests. *Conservation Biology*, **14(5):** 1435–1440 (2000).
10. Mishra, B. P., Tripathi, O. P. and Laloo, R. C., Community characteristics of a climax subtropical humid forest of Meghalaya and population structure of ten important tree species. *Trop. Ecol*., **46 (2):** 241-251(2005).
11. Goudie, A. S., The human impact on the natural environment: past, present, and future. London (UK): Wiley-Blackwell (2005).
12. Abadie J. C., Machon, N., Muratet, A., and Porcher E., Landscape disturbance causes small-scale functional homogenization, but limited taxonomic homogenization, in plant communities. *J Ecol*. **99(5):** 1134–1142 (2011).
13. Whittaker, R. H., Vegetation of the Siskiyou Mountains, Oregon and California. *Ecological Monograph,* **30(3):** 279–338 (1960).
14. Grime, J. P., Plant strategies and vegetation processes. New York (NY): Wiley (1979).
15. Naveh, Z. and Whittaker, R. H., Structural and floristic diversity of shrublands and woodlands in Northern Israel and other Mediterranean areas. *Plant Ecology*, **41(3):** 171–190(1980).
16. Bongers, F., Poorter, L., Hawthorne, W.D. and Sheil, D., The intermediate disturbance hypothesis applies to tropical forests, but disturbance contributes little to tree diversity. *Ecol. Lett*. **12(8):** 798–805(2009).
17. Ali, S.I., The significance of flora with special reference to Pakistan. *Pak. J. Bot*., **40:** 967-971(2008).
18. Keith, D.A., Floristic lists of New South Wales (III). *Cunninghamia*, **2:** 39-73(1988).
19. Sher, H. and Hussain, F., Ethnobotanical evaluation of some plant resources in Northern part of Pakistan. *Afr. J. Biotechnol*., **8(17):** 4066-4076 (2009).
20. Turner, W. R., Nakamura, T. and Dinetti, M., Global urbanization and the separation of humans from nature. *Biosci*., **54:** (2004) 585-590. Doi: 10.1641/0006 - 3568(2004) 054 (0585:GUATSO) 2.0. CO; 2
21. Louhaichi, M., Salkini, A.K. and Petersen, S.L., Effect of small ruminant grazing on the plant community characteristics of semi-arid Mediterranean ecosystems. *Int J Agr Biol* **11:** 681-689 (2009).
22. Zhao, L.P., Su, J.S., Wu, G.L. and Gillet, F., Long term effects of grazing exclusion on aboveground and belowground plant species diversity in a steppe of the Loess Plateau, China. *Plant Ecology and Evolution*, **144:** 313–320(2011).
23. Louhaichi, M., Ghassali F., Salkini A.K. and Petersen, S.L., Effect of sheep grazing on rangeland plant communities: case study of landscape depressions within Syrian arid steppes. *Journal of Arid Environments*, **79:** 101–106 (2012).

24. Li X.R., Jia, X.H., and Dong, G. R., Influence of desertification on vegetation pattern variations in the cold semi-arid grasslands of the Qinghai-Tibet plateau,North-west China. Journal of Arid Environments, **64:** 505–522 (2006).
25. Kotanen, P.M. and Rosenthal, J.P., Tolerating herbivory: does the plant care if the herbivore has a backbone? *Evol. Ecol*., **14:** 537-549 (2001).
26. Castro, H., Nabais, C., Alados, C.L., Freitas, H., Effects of cessation of grazing on leaf-level photosynthesis of *Periploca laevigata*. *Appl. Veg. Sci*. **6:** 255-260 (2003).
27. Golodet S C., Kigel, J. and Sternberg, M., Recovery of plant species composition and ecosystem function after cessation of grazing in a Mediterranean grassland. *Plant and Soil*, **329**: 365–378 (2010).
28. Wu G.L., Li., U. Z.H., Zhang L., Cheng, J.M. and Hu, T.M., Long-term grazing exclusion improved soil properties and soil organic carbon storage in an alpine swamp meadow of western China. *Plant and Soil*, **332**: 331–337 (2010).
29. Curtis, J. T. and McIntosh, R. P., The interrelations of certain analytic and synthetic phytosociological characters. *Ecol*., **31:** 434-455(1950).
30. Phillips, E.A., Methods of vegetation study. Henry Hold & Col. Inc. (1959).
31. Curtis, J. T., The vegetation of Wisconsin: An ordination of plant communities. University of Wisconsin Press, Madison, Wisconsin. 657 pp (1959).
32. Curtis, J. T, and Cotton, G., Plant Ecology Workbook: Laboratory Field Reference Manual. Burgess Publishing Co., Minnesota, 193 p (1956).
33. Shannon, C. E. and Weaver (Weiner) W., *The Mathematical Theory of communication*. University Illinois Press, Urbana, USA. (1963).
34. Simpson, E.H., Measurment of diversity. *Nature,* **163:** 688 (1949).
35. Margalef R. *Perspective in ecological theory*. University of Chicago Press, Chicago. (1958).
36. Pielou E. C**.,** Species diversity and pattern diversity in the study of ecological succession. *Journal of Theoretical Biology,* **10:** 370-383 (1966).
37. Lososova, Z., M. Chytry, S., Cimalova, Z., Kropac, Z., Otypkavo, P., Pysek, and Tichy. L., Weed vegetation of arable land in general Europe gradients in diversity and species composition. *Jour of Veg Sci.,* **15:** 415-422 (2004).
38. Gibson, C.W.D. and V.K. Brown., Grazing and vegetation change: deflected or modified succession? *Jour of App Ecol*., **29:** 120-131 (1992).
39. Hayes, G. F. and Holl, K. D., Cattle Grazing Impacts on Annual Forbs and Vegetation Composition of Mesic Grasslands in California, *Conservation Biology*, **17:** pp. 1694–1702 (2003).
40. Baron, V. S., Dick, A. C., Mapfumo, E. and Malhi, S. S., Grazing impacts on soil nitrogen and phosphorus under Parkland pastures, *Journal of Range Management,* **54:** pp. 704 – 710 (2001).
41. Keddy, P. A., Fraser, L. H. and Keogh, T. A., Responses of 21 wetland species to shortages of light, nitrogen and phosphorus, Bulletin of the *Geobotanical Institute ETH*, **67:** pp. 13- 25(2001).
42. Marty, J. T., Effects of Cattle Grazing on Diversity in Ephemeral Wetlands, *Conservation Biology*, pp. 1626–1632 (2004).
43. Pyke, R. and Marty, J. T., Cattle Grazing Mediates Climate Change Impacts on Ephemeral Wetlands, *Conservation Biology*, 36, pp. 1619–1625 (2004).
44. Menard, C., Duncan, P., Fleurance, G., Georges, J. Y. and Lila, M., Comparative foraging and nutrition of horses and cattle in European wetlands, *Journal of Applied Ecology*, **39:** pp. 120–133 (2002).
45. Jones, W. M., Fraser, L. H. and Curtis, J., Plant community functional shifts in response to livestock grazing in intermountain depressional wetlands in British Columbia, Canada, *Biological Conservation*, **144 (1):** pp. 511-517(2010).

46. Bullock, J. M., Franklin, J., Stevenson, M. J., Silvertown, J., Coulson, S., Gregory, S. J., and Tofts, R., A plant trait analysis of responses to grazing in a long term experiment, *Journal of Applied Ecology*, **38**: pp. 253- 267 (2001).
47. Middleton, T., Winter burning and the reduction of Cornus serecia in sedge meadows n southern Wisconsin, *Journal for the Society for Ecological Restoration*, **10(4):** pp. 723- 730 (2002).
48. Mharapara, M., Munema, M. D. and Mkwanda, R., Wetland characterization and classification for sustainable agricultural development, FAO, Zimbabwe country paper, Experiences on wetland characterisation, classification, management and utilization for agricultural development in Zimbabwe: a case for wetland research, FAO (1997).
49. Limpitlaw, D. and Rudigergens, M., Dambo mapping for environmental monitoring using Landsat TM and SAR imagery: Case study in the Zambian Copperbelt, *International Journal of Remote Sensing*, **27 (21):** pp. 4839–4845(2006).
50. Roberts, N., Dambos in development of a fragile ecological resource, *Journal of Biogeography*, **15:** pp. 141-148 (1988).
51. Caldwell, M., Richards, J.H., Johnson, D.A., Nowack, R.S. & Dzurec, R.S., Coping with herbivory: photosynthetic capacity and resource allocation in two semiarid *Agropyron* bunchgrasses. *Oecologia,* **50:** 14-24 (1981).
52. Briske, D.D. and J.H. Richards.,. Plant responses to defoliation: a morphological, physiological and demographic evaluation. *In*: Bedunah, D.J. and R.E. Sosebee (eds.), *Wildland Plants: Physiological Ecology and Developmental Morphology*, Society for Range Management, Denver, Colorado, pp: 635–710 (1995).
53. Ahmed, M., Raza, F.A., Masud, J. and Ali, I., Ecological assessment of production potential for rangeland vegetation in Southern Attock, Pakistan. *Int. J. Agric. Biol.*, **8:** 212–215 (2006).
54. Mosallam, H.A.M., Comparative study on protected and nonprotected areas. *Int. J. Agric. Biol.*, **9:** 202–214 (2007).
55. Milchaunas, D. G., Lauenroth, W. K., Quantitative effects of grazing on vegetation and soils over a global range of environments. *Ecological Monograph*, **63:** 327-366 (1993).
56. Osem, Y., Perevolotsky, A. and Kigel, J., Grazing effect on diversity of annual plant communities in a semi-arid rangeland. Interactions with small-scale spatial and temporal variation in primary productivity. *J. Ecol.*, **90:** 936–946 (2002).
57. Guillaume, D. Pattern of plant species and community diversity at different organization level in a forested riparian landscape. *Jour of Veg Sci*, **13:** 91-106 (2002).
58. Noy-Meir, I., Interactive effects of fire and grazing on structure and diversity of Mediterranean grasslands. *Journal of Vegetation Science* **6:** 701–710 (1995).
59. Belsky, A. J., Effects of grazing, competition, disturbance and fire on species competition and diversity in grassland communities. *J Veg Sci.*, **3:** 187-200 (1992).
60. Milchunas, D. G, Sala, O. E. and Lauenroth, W. K. A., generalized model of the effects of grazing by large herbivores on grassland community structure. *Amer Nat***., 132:** 87-106 (1988).
61. Catorci, A., Gatti, R. and Cesare, S., Effect of sheep and horse grazing on species and functional composition of sub-Mediterranean grasslands. *Appl Veg Sci.*, **15(4):** 459-469 (2012).
62. Dumont, B., D'hour, P. and Petit, M., The usefulness of grazing tests for studying the ability of sheep and cattle to exploit reproductive patches of pastures. *Appl Anim Behav Sci* **45:** 79-88 (1995).
63. Grant, S .A., Torvell, L., Sim, E. M., Small, J. L. and Armstrong, R. H., Controlled grazing studies on Nardus grassland: effects of between-tussock sward height and species of grazer on Nardus utilization and floristic composition in

two fields in Scotland. *J Appl Ecol* **33:** 1053-1064 (1996).

64. Lyaruu, H. V., The influence of soil characteristics on plant species diversify and distribution patterns in Western Serengeti, Tanzania. Ser. For. Bull., **5(3):** 234-241 (2010).
65. Shameem, S. A., Soni, P. and Bhat, G. A., Comparative study of herb layer diversity in lower Dachigam National Park, Kashmir Himalaya, India. *International Journal of Biodiversity and Conservation*, **2(10):** 308-315 (2010).
66. Shameem, S .A., Kangroo, I. N. and Bhat, G. A. Comparative assessment of edaphic features and herbaceous diversity in lower Dachigam national park, Kashmir, Himalaya. *Journal of Ecology and the Natural Environment.* **3(6):** 196-204 (2011).
67. Shameem, A. and Kangroo**.,** Comparative assessment of edaphic features and phytodiversity in lower Dachigam National Park, Kashmir Himalaya, India
68. Tripathi, S., Shukla, R. P., Effect of clipping and grazing on various vegetational parameters of grassland communities of Gorakhpur,U.P. *Trop. Ecol*., **48 (1):** 61-70 (2007).
69. Kharwa, G. P., Mehrotra, R. S., and Pangtey, Y. P. S**.,** Comparative study of herb layer diversity in pine forest stands at different altitudes of central Himalaya. *Applied Ecology and Environmental Research*, **2(2):** 15-24 (2004).
70. Willoughby, M. G., and Alexander, M. J., Rangeland health for native and modified plant communities in the Rough Fescue Ecological Site of the Montane Subregion. Alberta Sustainable Resource Development, Lands Division, Edmonton, Alberta. Publication No. T/150. ISBN No. 978-0-7785-6523-9 (2007).
71. Schei, P.J., Conclusions and recommendations from the UN/Norway. Conference on Alien species. *Sci. Int*., **63:** 32 (1996).
72. Moretti, M., Zanini, M. and Conedera, M., Faunistic and floristic post-fire succession in southern Switzerland: an integrated analysis with regard to fire frequency and time since the last fire. Forest Fire Research and Wildland Fire Safety, Viegas (Ed.), ISBN 90-77017-72-0 (2002).
73. Keith, R. P., Thomas, T. V., Tania, L. S. and Rosemary, L. S., Understory vegetation indicates historic fire regimes in ponderosa pine-dominated ecosystems in the Colorado Front Range. *J. Vegetation Science*, **21:** 488-499 (2010).
74. Decocq, G., Aubert, M., Dupont, F., Alard, D., Saguez, R. and Wattez-Franger, A., Foucault B, DE Delelis-Dusollier A, and Bardat J. Plant diversity in a managed temperate deciduous forest: understorey response to two silvicultural systems. *Journal of Applied Ecology*, **41:** 1065-1079 (2004).
75. X.G. Xiong, X.G. Han, Q.S. Chen, et al., Increased abundance of woody plants in grasslands and savannas, Acta Ecologica Sinica **23(11):** 2436–2443 (2003).
76. Hobbs, R.J., and Huenneke, L.F., Disturbance, diversity, and invasion: implications for conservation. *Conservation Biology,* **6:** 324-337 (1992).
77. Tilman, D., Community invisibility, recruitment limitation and grassland biodiversity. *Ecology*, **78:** 81-92 (1997).
78. Zhou, H., Tang, Y., Zhao, X., and Zhou, L., Long-term grazing alters species composition and biomass of a shrub meadow on the Qinghai-Tibet Plateau. *Pak. J. Bot*., **38(4):** 1055-1069 (2006).
79. Metzger, K. L., Coughenour, M. B., Reich, R. M., and Boone, R. B., Effects of seasonal grazing on plant species diversity and vegetation structure in semi-arid ecosystem. *J. Arid. Environ*., **61:** 147-160 (2005).
80. Adler, P., Raff, D., Launeroth, W., The effect of grazing on the spatial heterogeneity of vegetation. Oecologia, **128:** 465-479 (2001).
81. Rikhari, H. C., Negi, G. C. S., Ram, J. and Singh, S. P., Human induced secondary succession in alpine meadow of Central

Himalaya, India. *Arctic and Alpine Research.* **25:** 8-14 (1993).

82. Singh, Y.P., Kumar, A., and Rai, J. P. N., Species diversity as related to grazing pressure in alpine meadows of Nanda Devi Biosphere Reserve. Pro. Nat. Seminar on Biodiversity conservation and management, EPCO, Bhopal., pp.147-153 (2003).
83. Lalfakawma, U. K., Sahoo, S., Roy, K., Vanlalhriatpuia and Vanalalhluna, P. C. Community Composition and Tree Population Structure in undisturbed and Disturbed Tropical Semi-Evergreen Forest Stands of North-East India. *Applied Ecology and Environmental Research,* **7(4):** 303-318 (2009).
84. Lempesi, A., Kyriazopoulos, A. P., Orfanoudakis, M., G, Korakis., Soil Properties and Plant Community Changes along a Goat Grazing Intensity Gradient in an Open Canopy Oak Forest. *Notulae Botanicae Horti AgrobotaniciCluj-Napoca..* **41(2):** 567-575 (2013).
85. El-Khouly, A. A.L., Effects of human activities on vegetation diversity in Siwa Qasis. International Conference on Water Resources and Arid Environment (2004).
86. Bliss, L. C., Rosine and lipid content in alpine Tundra plants. *Ecology,* **43:** 753-757 (1962).
87. Mishra, D., Mishra, T. K. and Banerjee, S. K., Comparative phytosociological and soil physic-chemical aspects between managed and unmanaged lateritic land. *Annals of Forestry*, **5(1):** 16-25 (1997).
88. Kershaw, K. A., *Quantitative and Dynamic Plant Ecology*. 3rd Edn., ELBS and Edward Arnold Ltd, London, (1973).
89. Saxena, A. K. and Singh, J. S., A phytosociological analysis of woody species in forest communities of a part of Kumaon Himalaya. *Vegetation,* **50:** 3-22 (1982).