Indian J. Applied & Pure Bio. Vol. 39(2), 882-888 (2024). **ISSN: 0970-2091**
A Web of Science Journal

Spatial distributian of plants in the Temperate forest grazing lands of Garhwal Himalaya, India

***Smriti Kukshal and Sarika [2]Maheshwari**

Assistant Professor
[1]Department of Botany, Harsh Vidya Mandir (P.G.) College,
Raisi, Haridwar-247671 (India)
*Corresponding Author: email: *sharmavpooja@gmail.com

Abstract

The forest floor vegetation under different forests were used as grazing grounds particularly in Himalayas. Some of the contributing factors to the formation of grasslands included unrestricted cutting of trees for fuelwood and foliage food, the deliberate ground vegetation burning, animals grazing, and the harvesting of ground vegetation for use as forage. The objective of current study was aimed to analyze spatial distribution of plant existence in the temperate forest grazing lands of Garhwal Himalaya. Field survey was carried out in order to collect plants from the four study sites at an altitude of 1000msl -1500msl in the year 2014. The region was full of Pinus canopy with *Capillepedium parviflorum* grass in dominance. The majority of the living forms were herbaceous, followed by shrubs and trees. Perennating organs or buds position from the ground surface is used for studying life form pattern. The life-form pattern observations revealed a greater presence of therophytes (45) than hemi-cryptophytes (26). Therophytes act as markers for the level of biotic impact present in the ecosystem. The dominance of therophytes seems partially due to biotic stress as well as occasional burning. The species' distribution pattern was assessed by employing the A: F species value. In current study, most of the species showed contiguous dispersion, followed by random distribution across all seasons and sites. As a result of excessive exploitation of forests for essential resources, there is a growing commitment to safeguard, manage, and enhance the productivity of these forest grazing lands.

Key words : Grazing land; Life-form; Distribution pattern; Therophytes; Contiguous.

The study of spatial diversity patterns among species and the identification of relevant variables are important research areas of biogeography and ecology[9,19]. Considering this, the Himalayas serve as an excellent location, showcasing the most extensive bioclimatic

gradient found worldwide[19,24]. The Himalayan range, with broad variety of elevations and landforms, offer significant climatic gradients and other variables that contribute to habitat diversity. The vegetation types in Himalayas vary from valley bottoms to high mountain peaks, with different plant species dominating at different altitudes. For instance, the lower elevations are dominated by grasses and forbs, while the higher elevations are dominated by shrubs and stunted trees. The plant species found in temperate grazing lands of Garhwal Himalaya are mainly herbs and shrubs, with a few trees scattered throughout the landscape.

Grazing lands are ecological communities characterized by their extensive, dense ground cover of diverse herbaceous vegetation, primarily composed of grasses, with relatively few trees or shrubs. The vegetation in the grassland includes both perennial and annual grasses, along with a blend of forbs. The interaction of these species, their phenological behaviour, climatic conditions, edaphic factors, lopping, operating grazing and herbage removal are responsible for the composition of grassland communities[47]. The grassland also consist different forest covers. Extensive clearing of forests due to lopping, consecutive burning, grazing and abandoned cultivation has led to the development of wide spread grazinglands in submontane and montane zones.

The ground vegetation diversity is a result of multitude of factors including forest cover and the type of dominating species. The highest species number reflects inclination of every species to thrive, develop, and placed when favorable conditions are present. However, the ultimate outcome is shaped through existing environmental factors and the spectrum of adaptability and tolerance exhibited by a certain species[5]. Plant species distribution patterns are impacted by a variety of characteristics including height, aspect, slope, and soil type. According to Raunkiaer[41], the moisture and heat conditions of the environment are crucial in shaping the pattern of plant dispersion. In a certain ecosystem, a plant life-form is the sum of all of its biological processes that developed direct response to existing environment (Braun Blanquett, 1932). Raunkiers explained life-form as 'the sum total of the adaptations of a plant to climate'. Phanerophytes (P), Chaemophytes (Ch), Geophytes, Hemicryptophytes (He), Cryptophytes (Cr) and Therophytes (Th) are the common life form classes given by Raunkiaer[41]. Growth and life-form dispersion patterns in Indian Himalayan region are poorly known therefore, present study was focus on life form and distributional pattern of temperate forest grazing land of chir-pine community in Garhwal Himalaya. The gradual shift of natural conditions such as soil, area, precipitation, temperature, and human land distribution along altitudinal gradients[25,52] provides a unique opportunity to study how biological forms and patterns of distribution react to environmental changes, particularly those caused by humans[50]. As a result, the life form technique may be used to forecast future changes in the ecosystem structure[7,13,15,28].

In India, Life-forms and Biological spectra of grazinglands of Himalayas are explored by Meher-Homji[29]; Rajwar and Gupta,[38,39]; Saxena *et al.*,[45]; Bawa and Sen[2]; Bhandari *et al.*,[3]; Rana *et al.*,[40]; Reddy *et al.*,[43], Pattanaik *et al.*,[37]; Kukshal *et al.*,[26];

Dobhal *et al.,*[14]; Ghildiyal *et al*.,[18]; Vashistha *et al.,*[51]; Arila *et al*.,[1]; Shahid and Joshi,[46] and Das *et al*.,[11].

Location and time of the study :

Present investigations were carried in Badiyargarh in 2014. It is situated in Tehri Garhwal (latitude 30° 22'- 30° 14', Longitude 78° 56'- 78° 47') and 25 kilometers north of Srinagar Garhwal, stretching from 1000 to 1500 meters above sea level. The climate was typically monsoonal, with an annual precipitation total of 240cm, the majority of which fell during the rainy season. The climate was moderate, with pleasant summers and harsh winters.

Field survey was carried out in order to collect plants from the study sites. Plants were taken to the lab, where they were pressed, dried, and preserved using conventional methods. The specimens were recognized using similar flora[17,30,31], and their identity was confirmed by comparing them to actual specimens stored at HNB Garhwal University's Herbarium in Srinagar (GUH). Raunkiers[41] classified the species into several life-form groups based on morphology, habit, height, and kind of perennating buds.

Analysis :

The position and placement of a perennating organ or bud in respect to ground surfaces was used to classify species into life-forms. The ratio of abundance to frequency is a relative indicator of species dispersion in a population. Curtis and Cottam[10] proposed the following estimates for population distributions: Regular, Random and *Contiguous* Regular: less than 0.025; Random: between 0.025 and 0.05 and contiguous distribution: above 0.05

Life forms :

Analysis of plant life forms is helpful in identifying major phytoclimatic types, especially in places that experience very little disturbance. According to Pandit and Pahurkar[36], life forms are seen as indicators of climate and are thought to have developed in direct reaction to their surroundings. Findings for the life-form pattern revealed a greater number of therophytes (45) followed by hemi-cryptophytes (26) (fig. 1). The presence of them indicated that the locations were under severe biotic stress. Therophytes are indications of the extent of biotic effect on the ecosystem. The current findings support findings of Bharucha and Dave[6], who emphasized that greater therophytes are markers of the amount of human and animal impact on the ecosystem. Disturbance act as a selection pressure and specializes species according to the conditions it creates, paving way to fungivity even in closed communities[21]. The biological spectrum for mountainous vegetation along the altitude, incorporating pine forests individually, was provided by Saxena and Singh[44] in. They emphasized that the frequent fires, relative xericness, and shattered canopy that allow for profuse herbaceous growth at the time of wet season may be responsible for the therophyte character of pine forests' flora. According to Cain[8], Therophytes are found in locations with disrupted natural vegetation. In present investigation, dominance of therophytes seems partially due to biotic stress as well as occasional burning. The proportion of therophytes is

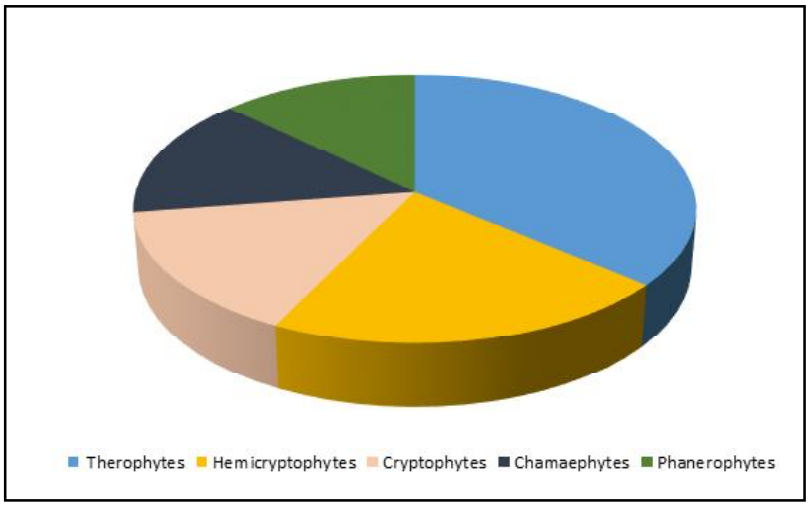

Fig 1. Biological spectrum of *Capillepedium parviflorum* community

Table-1. Distribution pattern (%) of all species in different seasons and stands

Site A	Winter	Spring	Summer	Rainy	Autumn	Pre-winter
Regular	*	*	*	*	*	*
Random	*	11.11(4)	25(6)	14.58(7)	25(11)	26.92(7)
Contiguous	100(18)	88.88(32)	75(18)	85.41(41)	75(33)	73.07(19)
Site B						
Regular	*	*	*	*	*	*
Random	*	3.03(1)	9.09(2)	5.26(2)	30.23(13)	16.66(6)
Contiguous	100(20)	96.96(32)	90.90(20)	94.73(36)	69.76(30)	83.33(30)
Site C						
Regular	*	*	*	*	*	*
Random	5.55(1)	9.67(3)	30(3)	4.65(2)	25(11)	18.75(6)
Contiguous	94.44(17)	90.32(28)	70(7)	95.34(41)	75(33)	81.25(26)
Site D						
Regular	*	*	*	*	*	*
Random	7.14(1)	6.25(1)	8.33(1)	18.75(6)	8.33(3)	33.33(7)
Contiguous	92.85(13)	93.75(15)	91.66(11)	81.25(26)	91.66(33)	66.66(14)

generally increased by biotic disturbances and relative dryness[8,12,51].

Distribution pattern :

Larger number of plant species demonstrated a contiguous dispersion pattern followed by random dispersion in all of the stands or locations (Table-1) Regular distribution was completely absent in the study area. This was observed in the findings of Gairola *et al*.[16], which showed that the contiguous distribution pattern was the most common distribution pattern in the temperate forest stands in the Garhwal Himalaya. The lack of regular dispersion patterns may endanger their populations in future[47]. Odum[32] asserts that contiguous dispersion is typical in nature, random distribution is seen in environment with extreme uniformity, and regular dispersion only appears in environments with extreme inter individual rivalry. Indicators of environmental consistency, the regular and random distribution patterns have been observed in plantation ecosystems by Pande *et al.*[33] as well as temperate Himalayan forests[45,49]. For the Garhwal Himalayan grazinglands, a contiguous pattern has also been observed[4,5,22,33]. Several other researchers have noticed an overall prevalence of contiguous distribution in vegetation while working in various different ecosystem[23,27,48]. Analysis of dispersion pattern indicated that almost all populations were contiguously distributed. This is consistent with the observations of several researchers that grasslands or grazing stands have a prevalence of distinct tuft types of grasses[3,47] and that many forbs prefer a certain microclimate. Contiguous distribution may predominate since the majority of plant species also have vegetative reproduction in addition to sexual reproduction. However, research indicates that contiguous dispersion in plants is generated by a number of processes, and vegetative reproduction may not be the only method of reproduction[23,45].

Study reports spatial distribution of plants in the temperate forest grazing land of Garhwal Himalaya. The findings lead to the conclusion that (a) Therophytes were found in greater abundance, followed by hemi-cryptophytes**.** Presence of therophytes are the result of biotic interference, and (b) most of the species displayed contiguous dispersion pattern followed by random distribution. Contiguous dispersion may predominate since most plant species may reproduce vegetatively in addition to sexually.

An elevated reliance on forest resources has heightened its susceptibility to human intervention. In recent years, the temperate grazing lands of Garhwal Himalaya have faced various challenges, including climate change, land-use change, and unsustainable grazing practices. These challenges have led to the degradation of these important ecosystems, threatening both the livelihoods of local communities and the biodiversity of the area. Therefore, it is crucial to comprehend the nature of life and the dispersion of plant species in the temperate grazing areas of the Garhwal Himalaya and to create sustainable management techniques to preserve and safeguard these vital ecosystems.

References :

1. Arila, K.E. and A. Gupta (2016). *Pleione 10*(1): 80–89.
2. Bawa, A.K. and D.N. Sen, (1994). *Range*

Mgmt. and Agroforestry. *15*(2): 129-133.
3. Bhandari, B. S., D.C. Nautiyal, and R.D. Gaur (1999). *J. Ind. Bot. Soc. 78:* 321-329.
4. Bhandari, B.S., J.P. Mehta and S.C. Tiwari (1995). *J. Hill Res*., *8:* 39-46.
5. Bhandari, B.S., J.P. Mehta, B.P Nautiyal, and S.C. Tiwari, (1997). *Int. Jour. Ecol. Environ. Sci*. *23*(1): 67-74.
6. Bharucha, F.R. and R.N. Dave (1944). *J. Univ. Bombay*. *13:* 15-16.
7. Broennimann, O., P. Vittoz, D. Moser, and Guisan, (2005), *Bot. Helv. 115*: 95–108.
8. Cain, S.A. (1950). *Bot. Rev. 16:* 1-32.
9. Colwell, R.K. and D.C. Lees. (2000). *Trends Ecol. Evol. 15*(2): 70–76.
10. Curtis, J.T. and G. Cottam, (1956). Plant Ecology Workbook. Laboratory Field Reference Manual. Burgress Publishing, Minnesota. 193pp.
11. Das, D. S., D. S. Rawat, M. Debabrata, S. Sudhansu, and B. K. Sinha, (2020). *Taiwania 65*(2): 154-162, DOI: 10.6165/tai.2020.65.154
12. Daubenmire, R. (1968). Plant Communities. A Text Book of Plant Synecology. Harper and Row, Publ., New York. 300pp.
13. De Bello, F., J. Leps, and M.T. Sebastia, (2006) *Ecography 29*: 801–810.
14. Dobhal, P., S.L. Bisht, S. Sawan, S.P. Joshi and V. Joshi. (2010). *Indian J. For*. *33*(4): 585–598.
15. Ebeling, A., S. Pompe, J. Baade, N. Eisenhauer, H. Hillebrand, R. Proulx, C. Roscher, B. Schmid, C. Wirth, and W.W. Weisser, (2014) *Basic Appl. Ecol. 15*: 229–240.
16. Gairola, S., C. M. Sharma, S. Suyal, and S. K. Ghildiyal, (2011). *Forestry Studies in China, 13*(2), 139. https:// doi.org/10.1007/s11632-011-0207-6
17. Gaur, R. D. (1999). Flora of the District Garhwal North West Himalayan (with Ethnobotanical notes). Transmedia, Garhwal, India.
18. Ghildiyal, J.C. and M. Juyal (2010). *Indian J. For*. *33*(3): 383–393.
19. Grytnes, J.A. and O.R. Vetaas. (2002). *Am. Nat. 159*(3): 294–304.
20. Grytnes, J.A., E. Heegaard and P.G. Ihlen. (2006). *Acta Oecol. 29*(3): 241-246.
21. Harper, J. L. (1977). Population Biology of Plants. Academic Press. London.
22. Joshi, N.K. and S.C. Tiwari, (1990). *Ind. J. For*. *13:* 322-328.
23. Kershaw, K.A. (1973). Quantitative and Dynamic Plant Ecology. Edward Arnold Ltd London. 305pp.
24. Khan, S.M., S. Page, H. Ahmad and D. Harper. (2012). *Pakistan. Pakistan J. Bot. 44:* 231–238.
25. Körner, C. (2007) *Trends Ecol. Evol.*, *22*: 569–574.
26. Kukshal S., B.P Nautiyal, A. Anthwal, A. Sharma and A. Bhatt (2009). *Research Journal of Botany 4*(2): 55-69.
27. Kunhikannan, C., K. Verma, Ram, Raj K. Verma, P.K. Khatri, and N.G. Totey, (1998). *Environment and Ecology*, 16(3): 539-548.
28. Marini, L., A. Battisti, E. Bona, G. Federici, F. Martini, M. Pautasso, and P.E. Hulme, (2012) *Glob. Ecol. Biogeogr.*, *21*: 534–544.
29. Meher-Homji (1981). *Journal of Economic and Taxonomic Botany 2:* 23–30.
30. Naithani, B.D., (1984) Flora of Chamoli, Vol. 1. Howrah-Botanical Survey of India, Calcutta.
31. Naithani, B.D., (1985). Flora of Chamoli, Vol 2. Howrah-Botanical Survey of India, Calcutta.

32. Odum, E.P. (1971). *Fundamentals of Ecology.* 3rd Edition. W.B. Saunders Co., Philadelphia.
33. Pande, P.K., A.P.S. Bisht and S.C. Sharma (1988). *Indian Forester*. *114*(7): 379-389.
34. Pande, P.K., J.D.S. Negi and S.C. Sharma (1996). Plant species diversity and vegetation analysis in moist temperate Himalayan Forests. *Abstract* First Indian Ecological Congress, New Delhi. 27-31.
35. Pandey, P.K., S.C Sharma, and S.K. Banerjee, (2002). *Ind J Trop Bio*, *10:* 19-27.
36. Pandit, B.R., and A. J. Pahurkar, (1998). Vegetational Studies in Piran Island near Bhavnagar (Gujarat). *Flora and Fauna*. *4* (2): 79-85
37. Pattanaik, C., C.S. Reddy and A.K. Biswal (2007). *Indian J. Forestry. 30*(3): 307 – 313.
38. Rajwar, G.S. and S.K. Gupta, (1981). *Ind. J. Forestry 4:* 49-55.
39. Rajwar, G.S. and S.K. Gupta. (1984). *Indian For. 110*(12): 1171–1176.
40. Rana, T.S., B. Datt and R. Rao. (2002). *Taiwania 47*(2): 164–169.
41. Raunkiaer, C. (1934). *The Life- forms of Plants and Statistical Plant geography*. The Clarendon Press, Oxford. 632pp
42. Reddy, C.S., P.H. Krishna, S.L. Meena, R. Bhardwaj and K.C. Sharma. (2011). *Int. J. Environ. Sci. 1*(7): 1632–1639.
43. Reddy, K.N., S.N. Jadhav, C.S. Reddy, and V.S. Raju, (2002). Life forms and Biological spectrum of Marriguda Reserve Fores Khammam district, Andhra Pradesh. *Indian For*. *128*(7): 751–756.
44. Ricklefs, R.D. (1979). Ecology. Thomas Nelson and Sons Ltd.
45. Saxena, A.K. and J.S. Singh, (1982). A Phytosociological analysis of woody species in forest communities of a part of Kumaon Himalaya. *Vegetatio*. *50:* 3-22.
46. Shahid, M. and S.P. Joshi. (2018). Life-forms and biological spectrum of dry deciduous forests in Doon Valley, Uttarakhand, India. *J. Am. Sci*. *14*(5): 30–34.
47. Shankar, U. (2001). A case of high tree diversity in a Sal (Shorea robusta)-dominated lowland forest of Eastern Himalaya: floristic composition, regeneration and conservation. Current Science, *81*(7): 776–786.
48. Singh, J.S. and P.S. Yadava, (1974). Seasonal variation in composition, plant biomass and net primary productivity of a tropical grassland at Kurukshetra. India. *Ecol. Monogr. 44:* 351-75.
49. Singhal, R.M., V.R.S. Rawat, Kumar, Pramod., S.D. Sharma, and H. B. Singh, (1986) ss. Vegetation analysis of woody species of some forest of Chakrata Himalaya, India. *Ind. For*. *112*(2): 819-823.
50. Sundqvist, M.K., N.J. Sanders, and D.A. Wardle (2013). Community and ecosystem responses to elevational gradients: Processes, mechanisms, and insights for global change. *Annu. Rev. Ecol. Evol. Syst. 44*: 261–280.
51. Vashistha, R. K., N. Rawat Chaturvedi, A.K, Nautiyal B.P., P. Prasad and M. C. Nautiyal (2011). Characteristics of life-form and growth-form of plant species in an alpine ecosystem of North-West Himalaya. *J. For. Res*. *22*(4): 501-506.
52. Whittaker, R.H. Gradient analysis of vegetation. *Biol. Rev.* 1967, *42*: 207–264.