Environment Conservation Journal 12(3) 73-78, 2011
(ISSN 0972-3099) Abstracted and Indexed

Phytosociological characters of forest vegetation in Tarai of KumaunHimalaya, Uttarakhand

Bhasker Joshi[1]✉and S. C. Pant[2]

Received: 20.12.2010 **Revised: 15.06.2011** **Accepted: 16.10.2011**

Abstract

The present work aimed to study the phytosociological characters of forest vegetation in mixed deciduous forest of Tarai of Kumaun Himalaya near Kashipur. Phytosociological characters of vegetation were calculated for all forest layers i.e. trees, shrubs and herbs. In this review, we are discussing different phytosociological characters and compare it with various forest types of Himalaya.

Keywords:*Forest vegetation, herb, Kumaunhimalaya, phytosociological characters, sapling, seedling, shrub, tarai, tree.*

Introduction

Vegetation of an area varies from place to place according to habitat heterogeneity of the area itself. It is also a key factor, which determines the structure of an ecosystem and ecological parameters within a plant community such as microclimate, energy budget, photosynthesis, water regimes, surface runoff and soil temperature (Tappeiner and Cernusca, 1996). The description and classification of the plant community in an ecosystem is known as phytosociology (Braun-Blanquet, 1932; Odum, 1971). Himalaya, the youngest mountain system of the world, constitutes an important link between the vegetation of the southern peninsular India on the one hand, the eastern Malaysian, the northeastern Sino-Japanese and the northern Tibetan areas on the other (Puri*et al.*, 1983). The various changes in the Himalayan forests are appearing in their structure, density and composition due to global warming (Gaur, 1982), uncontrolled lopping and utilization of trees for fuel wood, fodder and grazing (Kumar *et al.*, 2004).

Author's Address

[1]Department of Botany (R. H. Govt. P. G. College, Kashipur), Kumaun University, Nainital, Uttarakhand), India
[2]Government Degree College, Gairsain, Chamoli (State-Uttarakhand) India.
Email:bhaskerjoshiphd@yahoo.com

There is little information available for vegetational analysis in Tarai and Bhawar area of Kumaun by Pant (1976), Jain and Sastry (1983) and Pant *et al.*, (1981). Therefore, the aim of this paper is to incorporate the seasonal variation in phytosociological characters of the submontane forest vegetation at Tarai of Kumaun Himalaya.

Geographical Location and Climate

For the present study, the forest of Tarai area near Kashipur of Kumaun Himalaya was selected having 558.38 hectare forest area (Source: Office of Tarai West Forest Division, Kumaun, Ramnagar). This study was conducted from April 2007 to March 2008. The study site was situated in the foothills of Shivalik Mountain of the Outer Himalaya and southeast to Corbett National Park at an elevation of 253.4 m above msl, within the district of Udham Singh Nagar. The climate is monsoonic with 1414.70±175.46 mm year^{-1}annual rainfall. The average monthly maximum temperature ranged from 16.7±2.26°C to 38.0±0.70°C and minimum temperature was in the range of 8.2±1.20 to 23.4±0.98°C.

Material and Methods

Phytosociological Analysis of Vegetation

Herbs

The phytosociological analysis of forest floor vegetation was conducted by using 200 quadrats of 1x1meter with in seasonal intervals. The quadrats were laid randomly, covering all area and directions. The quadrats size was determined by the species area curve following Misra (1968).

Shrubs

The phytosociological analysis of shrubs in study sites were conducted by using 100 quadrats of 10x10 meter with in seasonal intervals. The quadrats were laid randomly, covering all area and directions.

Trees

The phytosociological analysis of trees in study sites were conducted seasonally by using 25 quadrats of 10x10meter. The size was determined following Saxena and Singh (1982). The quadrats were laid randomly, covering all area and directions.The data so obtained was calculated on seasonal basis i.e. summer (April and May), Rainy (June, July, August and September), winter (October, November, December and January) and spring (February and March). The phytosociological characteristics were quantitatively analyzed following methods described by Curtis and Mc. Intosch (1950), Curtis (1959), Phillips (1959) and Misra (1968). A/F ratio was calculated by Whitford (1949) method. Species diversity (H) and Concentration of Dominance (Cd) for all the tree layers at each site was calculated by using Shannon–Wiener Information Index (Shannon and Wiener, 1963) and Simpson's index (Simpson, 1949) respectively.

Results and discussion

In present study density for trees, saplings, seedling, shrubs and herbs were reported in a range of 664-808 ind ha^{-1}, 36-336 ind ha^{-1}, 344-596 ind ha^{-1}, 1096-1776 ind ha^{-1} and 345-481 ind m^{-2}. These results were similar as reported by Devi and Yadava (2006) in a tropical semi evergreen forest of Manipur as density for trees, saplings, seedling, shrubs and herbs amounting as 685-820 ind ha^{-1}, 95-795 ind ha^{-1}, 15500-17504 ind ha^{-1}, 2340-3060 ind ha^{-1} and 27.3-42.65 ind m^{-2}. In addition, they reported Shannon-Weiner Index for trees, saplings, seedling, shrubs and herbs as 0.1094-1.1782, 0.6285-0.7595, 1.3180-1.3323, 1.6432-2.4544 and 2.4985-2.2944 respectively. Simpson Index for trees, saplings, seedling, shrubs and herbs as 0.5554-0.9712, 0.7106-0.7340, 0.4486-0.4581, 0.2574-0.3467 and 0.2259-0.2304 respectively. Total tree density for temperate forests of Kumaun Himalaya was ranged from 420-1640 trees/ha (Saxena and Singh, 1982).Gairola*et al.,* (2008) reported the tree density 243-843 ind ha^{-1}, sapling density 2200-8333 ind ha^{-1}, seedling density 1867-10135 ind ha^{-1}, shrub density 813-4357 ind ha^{-1} and herb density 5.51-21.35 ind m^{-2} in Garhwal and Kumaun region of West Himalaya.They also reported basal area of trees as 8.94-69.84 m^2 ha^{-1}. Kumar *et al.,* (2004) estimated the density of trees in sub tropical forest of Garhwal Himalaya amounting 656 to 888 ind ha^{-1}. Kumar and Bhatt (2006) observed Shannon-Weiner Index (H) for forest vegetation amounting 4.580-4.643 for trees, 4.695-5.021 for shrubs and 4.962-4.986 forherbs

Table 1.0: Phytosociological characters of herbs

S. No	Season	No. of Plant Species	D	A/F Ratio	TBA	IVI	H	Cd
1	Summer	47	345±13.00	0.01-4.08	26.28±0.81	0.46-57.96	1.333±0.03	0.0866±0.009
2	Rainy	70	430±14.30	0.01-3.60	101.53±5.40	0.33-142.51	1.361±0.025	0.0906±0.008
3	Winter	58	403±12.47	0.01-3.34	55.39±2.17	0.35-52.42	1.446±0.025	0.0718±0.005
4	Spring	54	481±12.54	0.02-3.64	38.01±1.05	0.46-34.40	1.368±0.027	0.0545±0.003

Abbreviation: D (Density [plant m^{-2}]), TBA (Total basal area [cm^2 m^{-2}]), IVI (Important Value Index), H (Shannon-Weiner Index), Cd (Simpson Index)

Table 2.0: Phytosociological characters of shrubs in summer, rainy, winter and spring seasons

S. No.	Season	No. of Plant Species	D	A/F Ratio	H	Cd
1	Summer	09	12.92±1.75	0.21-8.00	0.676±0.06	0.2588±0.046
2	Rainy	14	10.96±1.21	0.22-12.00	0.771±0.054	0.2287±0.039
3	Winter	13	17.76±1.60	0.18-8.00	0.843±0.055	0.1743±0.022
4	Spring	11	15.48±1.47	0.40-4.00	0.821±0.054	0.1817±0.025

Abbreviation: D (Density [plant 100m^{-2}]), A/F (Abundance / Frequency), H (Shannon-Weiner Index), Cd (Simpson Index)

Table 3.0: Phytosociological characters of trees

S. No.	Season	No. of Plant Species	D	A/F Ratio	TBA	IVI	H	Cd
1	Summer	17	7.64±0.81	0.06-1.25	5414.74±538.27	2.38-103.14	0.814±0.044	0.2439±0.045
2	Rainy	18	7.12±0.59	1.00-7.14	5354.04	2.94-86.14	0.95±0.04	0.1757±0.025
3	Winter	17	8.08	0.06-0.50	5761.83±641.96	2.40-107.20	0.774±0.045	0.2650±0.047
4	Spring	19	6.64±0.63	0.05-0.50	5289.43±466.79	2.39-99.29	0.892±0.040	0.2200±0.039

Abbreviation: D (Density [plant 100m^{-2}]), A/F (Abundance / Frequency), TBA (Total basal area [cm^2 100m^{-2}]), IVI (Important value index), H (Shannon-Weiner Index), Cd (Simpson Index)

Table 4.0: Phytosociological characters of sapling

S. No	Season	No. of Plant Species	D	A/F Ratio	TBA	IVI	H	Cd
1	Summer	04	0.36±0.035	0.04-0.12	16.92±1.82	42.90-2.36	0.569±0.023	0.2838±0.045
2	Rainy	08	3.36±0.86	0.07-0.50	69.84±14.38	8.32-72.78	0.412±0.044	0.6168±0.203
3	Winter	07	2.16±0.44	0.17-0.75	51.10±8.15	10.86-122.74	0.496±0.053	0.4122±0.112
4	Spring	06	1.12±0.16	0.11-0.75	38.63±5.26	14.12-87.44	0.632±0.044	0.2805±0.067

Abbreviation: D (Density [plant 100m^{-2}]), A/F (Abundance / Frequency), TBA (Total basal area [cm^2 100m^{-2}]), IVI (Important value index), H (Shannon-Weiner Index), Cd (*Simpson Index*)

Table 5.0: Phytosociological characters of seedling

S. No.	Season	No. of Plant Species	D	A/F Ratio	H	Cd
1	Summer	5	3.44±0.69	0.12-0.81	0.485±0.059	0.3818±0.109
2	Rainy	10	5.96±0.85	0.08-1.25	0.661±0.054	0.2942±0.063
3	Winter	9	4.96±0.86	0.07-2.00	0.571±0.054	0.3698±0.080
4	Spring	7	3.72±0.95	0.11-1.91	0.408±0.034	0.5698±0.199

Abbreviation: D (Density [plant 100m^{-2}]), A/F (Abundance / Frequency), H (Shannon-Weiner Index), Cd (Simpson Index)

Table 6.0: List of Plants reported during phytosociological analysis of forest vegetation

S. No.	Name of Plant Species	Habitat	S. No.	Name of Plant Species	Habitat
1	*Acacia catechu* Willd.	Herb	**74**	*Helminthostachyszeylanica*L.	Fern
2	*Achyranthesaspera*L.	Herb	**75**	*Hemigraphisrupestris*(Heyne ex T. Andr.)	Herb
3	*Adenostemmalavenia*L.	Herb	**76**	*Holarrhenaantidysenterica*Wall.	Tree
4	*Adiantumcapillus-veneris*L.	Fern	**77**	*Hydrocotyljavanica*Thunb.	Herb
5	*Adiantumincisum*Forssk.	Fern	**78**	*Ipomoea eriocarpa*R.Br.	Herb
6	*Aervascandens*Wall.	Herb	**79**	*Justiciaprocumbens*L.	Herb
7	*Ageratum conyzoides*L.	Herb	**80**	*Lactuca sativa* L.	Herb
8	*Ajugabracteosa*Wall. exBenth.	Herb	**81**	*Lanneacoromandelica*Hontt.	Tree
9	*Albizziaprocera*Benth.	Tree	**82**	*Lantana camara*L.	Shrub
10	*Alternantherasessilis*R.Br.	Herb	**83**	*Lepidagathispurpuricaulis*Nees	Herb
11	*Amaranthusviridis*L.	Herb	**84**	*Leucascephalotes*(Roth) Spreng.	Herb
12	*Anagallisarvensis*L.	Herb	**85**	*Limnophilarugosa*Roth.	Herb
13	*Antirrhinum orontium*L.	Herb	**86**	*Linderniaanagallis*(Burm.f.)	Herb
15	*Arthraxonlancifolius* (Trin.) Hochst	Herb	**87**	*Ludwigiaoctovalvis* (Jacq.) Raven.	Herb
16	*Bidensbiternatea*Merr. &Sherf	Herb	**88**	*Ludwigiaprostrata*Roxb.	Herb
17	*Biophytumsensitivum*Zucc.	Herb	**89**	*Lygodiumflexuosum* (L.) Sw.	Fern
18	*Blumeamollis*D.Don	Herb	**90**	*Mallotusphilippenensis*Muell. Arg.	Tree
19	*Blumeaoxyodenta* DC.	Herb	**91**	*Malvastrumcoromandelianum*Garcke.	Herb
20	*Boehmariascabra*Gaud.	Herb	**92**	*Mazusjaponicus*Thunb.	Herb
21	*Boerhaaviadiffusa*L.	Herb	**93**	*Meliaazedarach*L.	Tree
22	*Bombaxceiba*L.	Herb	**94**	*Melochiacorcorifolia*L.	Herb
23	*Bothriospermumtenellum*Hornem.	Herb	**95**	*Murrayakoenigii*Spreng.	Shrub
24	*Buteamonosperma*(Lamk).Thub.	Tree	**96**	*Nicotianaplumbaginifolia*Viv.	Herb
25	*Callicarpamacrophylla*Vahl	Shrub	**97**	*Ophioglossumreticulatum*L.	Fern
26	*Calotropisprocera*R.Br.	Shrub	**98**	*Oxalis acetosella*L.	Herb
27	*Cedrelatoona*Roxb.	Tree	**99**	*Oxalis corniculata*L.	Herb
28	*Centellaasiatica*(L.) Urb.	Herb	**100**	*Oxalis dehradunensis*Raizada	Herb
29	*Ceratopteristhalictroides*Brong.	Fern	**101**	*Partheniumhysterophorus* L.	Herb
30	*Chlorisdolichostachya* Lag.	Herb	**102**	*Paspalidiumflavidum* Retz.	Herb
31	*Cissampelospareira*L.	Climber	**103**	*Peristrophebicalyculata*Retz.	Herb
32	*Clerodendrumviscosum*Vert.	Shrub	**104**	*Peucedanumdhana*Ham.	Herb
33	*Cocciniacordifolia*Cogn.	Climber	**105**	*Phalaris minor* Retz.	Herb
14	*Argemonemexicana*L.	Herb	**106**	*Phyla nodiflora*(L.) Greene	Herb
34	*Colebrookiaoppositifolia*Smith	Shrub	**107**	*Phyllanthusdebilis*	Herb
35	*Commelinapadulosa*Blume	Herb	**108**	*Phyllanthusfraternus* Webster.	Herb
36	*Conyzastricta*Willd.	Herb	**109**	*Phyllanthusniruri*L.	Herb
37	*Corchorusaestuans*L.	Herb	**110**	*Physalis minima* L.	Herb
38	*Cordiamyxa*L.	Tree	**111**	*Plectranthusjaponicus*Burm.f.	Herb
39	*Crotalaria medicaginea*Lamk.	Herb	**112**	*Pogostemonebenghalense*(Burm.f.) Kuntz	Shrub
40	*Croton sparsiflorum*Morong.	Herb	**113**	*Polygonumbarbatum*L.	Herb
41	*Cynodondactylon*(D) Pers.	Herb	**114**	*Polygonumhydropiper*L.	Herb
42	*Cynoglossumlanceolatum*Forssk.	Herb	**115**	*Polygonumplebejum*R.Br.	Herb
43	*Cyperusbrevifolius* (Rottf.) Hassk.	Herb	**116**	*Pouzolziaindica*Gaud.	Herb
44	*Cyperusiria*L.	Herb	**117**	*Pterisvittata* L.	Fern
45	*Cyperuspaniceus* (Rottb.) Boeck.	Herb	**118**	*Ranunculus scleratus*L.	Herb
46	*Cyperuspumilus* L.	Herb	**119**	*Rumexdentatus*L.	Herb
47	*Cyperusrotundus*L.	Herb	**120**	*Rungiapectinata*L.	Herb
48	*Dalbergiasisso*Roxb.	Tree	**121**	*Salvia plebeiaR.Br.*	Herb
49	*Desmodiumconcinnum* DC.	Herb	**122**	*Saussureaheteromalla*D.Don	Herb
50	*Desmostachyabipinnate*Stapf	Herb	**123**	*Scopariadulcis*L.	Herb
51	*Diclipteraroxburghiana*Nees	Herb	**124**	*Setariaglauca*Beauv.	Herb
52	*Digitariacruciata*Nees	Herb	**125**	*Sidaacuta*Burm.	Herb
53	*Digitariastricta* Roth. ex R. & S. Syst.	Herb	**126**	*Siegesbeckiaorientalis*L.	Herb
54	*Diplaziumesculentum*(Retz.) Sac.	Fern	**127**	*Solanumincanum*L.	Shrub
56	*Ecliptaprostrata*Roxb.	Herb	**128**	*Solanumnigrum*L.	Herb
57	*Elephantopusscaber*L.	Herb	**129**	*Solanumverbascifolium*L.	Shrub
58	*Eleusineindica*Gaertn.	Herb	**130**	*Sonchusoleraceous*L.	Herb
59	*Emilia sonchifolia*DC.	Herb	**131**	*Sporobolusdiander*Beauv.	Herb
60	*Equisetum diffusum*D.Don	Fern	**132**	*Stellaria media* L.	Herb
61	*Erigeron bonariensis*L.	Herb	**133**	*Tectonagrandis*L.f.	Tree
62	*Eucalyptus hybrid* L.Herit.	Tree	**134**	*Tephrosiapurpurea*Pers.	Herb
63	*Eugenia jambolana*Lam.	Tree	**135**	*Thelypterisprolifera* Retz.	Fern
64	*Euphorbia heliosocopia*L.	Herb	**136**	*Toreniacordifolia*Roxb.	Herb
65	*Euphorbia hirta*L.	Herb	**137**	*Trewianudiflora*L.	Tree
66	*Ficuspalmata*Forssk.	Tree	**138**	*Tridaxprocumbens*L.	Herb
67	*Ficusracemosa*L.	Tree	**139**	*Vernoniacinerea*Less.	Herb
68	*Fimbristylisdichotoma*(L.) Vahl	Herb	**140**	*Vernonicaanagallis-aquatica*L.	Herb
69	*Fumariaindica*Haussk.	Herb	**141**	*Vetiveriazizaniodes*Nash.	Herb
70	*Galiumvestitum*D.Don	Herb	**142**	*Vicia sativa* L.	Herb
71	*Glycosmispentaphylla*Corrca.	Tree	**143**	*Youngia japonica* DC.	Herb
72	*Gnaphaliumluteoalbum*L.	Herb	**144**	*Zingibercapitatum*Roxb.	Herb
73	*Haplophagmaadenophyllum*Wall.	Tree	**145**	*Zizyphusjujuba*Lamk.	Shrub

andSimpson Index value for trees was 0.053-0.114, 0.040-0.049 for shrubs and 0.039-0.039 for herbs in forests at foot hills of Garhwal Himalaya.

The analysis of distribution pattern of herbs, shrubs and trees shows contagious distribution. Kumar and Bhatt (2006) also reported the contagious distribution pattern in forests of Garhwal Himalaya. Kharkwal and Rawat (2010) reported the total abundance-frequency A/F ratio of tree, shrub and herb species in different sampling sites ranged from 0.23 to 1.25, 0.25 to 1.79 and 3.4 to 27.3, respectively.

According to Odum (1971), contagious distribution is the commonest pattern in nature and random distribution is found in uniform environments.

Several workers (Kershaw, 1973; Singh and Yadava, 1974) have reported the contagious distribution in natural vegetation. Based on IVI values, the name of herbaceous communities is *Cynodondactylon-Saussureaheteromalla* in summer season, *Ageratum conyzoides-Rungiapactinata* in rainy season, *Ageratum conyzoides-Stellaria media* in winter season and *Cynodondactylon-Saussureaheteromalla* in spring season. However based on IVI values, the tree communities can be named as *Eucalyptus hybrid–Tectonagrandis* (Summer Season), *Tectonagrandis- Eucalyptus hybrid* (Rainy Season), *Eucalyptus hybrid–Tectonagrandis*(Winter Season) and *Eucalyptus hybrid–Tectonagrandis*(Spring Season).

Conclusion

The study points out phytosociological characters of forest vegetation in Tarai region of Kumaun Himalaya. The density of forest vegetation (herb, shrub, trees, sapling and seedling) is higher as compare to temperate forest of Garhwal and Kumaun (Central) Himalaya. Therefore, there is an urgent need for the conservation of biodiversity in Tarai forests of Kumaun Himalaya. Thus, this study will helpful for researcher for better understanding about structure of forest vegetation in Tarai of Kumaun Himalaya.

Acknowledgement

One of us (BJ) gratefully thanks to Prof. Y.P.S. Pangtey for their help in plants identification and Department of Tarai West Forest Division, Uttarakhand, India for their able guidance and useful informations in this study.

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