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Species diversity in two different forest of Siwalik Range in J&K Himalaya, India

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Abstract

The present study deals with the species diversity of two identified forest i.e., mixed broad leaved forest (Forest type-1) and pine forest (Forest type-2) of Shiwalik range in J&K Himalaya. Ten plots of 10×10 m were randomly established in the forest for the determination of species diversity and other vegetation parameter ranging from 500-1200m asl. *Acacia modesta* was the dominant species of forest type-1 followed by *Mallotusphilippensis*, *Cassia fistula*, etc. *Pinusroxburghii* was the dominant tree species of forest type-2 but also shows some sort of dominancy in forest type-1. Shrubs and herbs diversity and density was shown decreased with pine dominating forest. It was also observed that the studied forest was unstable and degraded, and will be vanished if not maintained properly.

Keywords:*Broad leaved forest, distribution pattern, disturbance effect, Pine forest, regeneration status, Species diversity*

Introduction

The forest is defined as "a plant community predominately of trees and woody vegetation usually with a closed canopy". The Indian sub-continent was under forest vegetation for quite a long time; however, the area under forest is gradually shrinking due to the increasing demands of the exploding population for forest products including pastures. Forests are a good asset in every country. They yield material for industries, timber for housing and other purposes and fuel wood for the poor masses. They also ensure aesthetic value, helps in precipitation, check floods and prevent soil erosion. Unfortunately, this highly valued wealth has been vanishing owing to the reckless activities of man. According to UN estimate, an acre of forests is being destroyed every second. India's forest loss has been particularly heavy (Anonymous, 1987).Besides exploring floristic diversity and invention of the plant resources of the western Himalayas and the State J&K, documents about phyto-sociological diversity as well as ethno-medicinal utilization of plants has been initiated by several worker during last two decades(Champion *et al.*,1965; Saxena and Singh., 1982; Negi, 2009; Pande, 2001; Mishra *et al*. 2003.; Sharma *et al*., 2009; Jain, 1991; Singh &Kumar, 2000; Anjula*et al*., 2007; Gupta *et al*., 1982; Kachroo&Nahvi., 1976; Kaul*et al*., 1987).

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Study area

The present study was conducted in sub-tropical Chir Pine forest of block Nowshera District Rajouri (J&K) in the year 2009-2010. The study area is located at an elevation ranges from 500 -1200 m asl and lies between of 32^0-57' to 33^0-17' N latitude and of 70^0-0' to 74^0-33' E longitude. The study area lies in South-West of the District Rajouri and in Western circle of the Jammu division. It is bounded by block Rajouri in North, Kalakote and Sunderbani in East and Mirpur Pakistan in West and South. Most of the area is mountainous and rugged. Landscape consists of low lying undulating hills and valleys. Northward topography become very steep and high merging ultimately with PirPanjal range near Ans River. Soil under forest is characterized by sandstone, shale, clay and calcareous sandstone in lower siwalik and massive,

soft, coarse, sandstone with sub ordinate clay in upper siwalik. The annual rainfall ranges from 920-960mm. The minimum and maximum temperature throughout the year ranges from 9^0C to 32^0C.Although some ethno-botanical studies in sub-tropical belt of the study area have been carried out (Rashid *et al*., 2008; Dangwal*et al.*, 2010, 2011), but no quantitative data on phyto-sociology of this block is available. The present study describes the species composition, regeneration status and distribution pattern of two different forest type in siwalik range of J&K Himalaya.

Material and Methods

The present study was undertaken to find out the species diversity of two different forest types i.e., mixed broad leaved forest (Forest type-1) and pine forest (forest type-2). Phyto-sociological studies were conducted during 2009-2010. The plants were indentified with the help of published regional forest flora of Jammu and Kashmir (Sharma &Kachroo, 1983; Swami & Gupta, 1998; Gaur, 1999). Tree layer was analysed by sampling of 10 randomly placed quadrats of 10×10 m size in each forest. The samples was quantitatively analysed for abundance, density and frequency (Curtis &McIntosh, 1950). Importance Value Index (IVI) for the tree layer was determined by following Curtis and Cottom 1956. The Distribution pattern of different species was studied by using ratio of abundance to frequency (Whitford, 1949). Tree species were considered to be individuals >30cm cbh (circumference at breast height) and sapling 10-30cm cbh and seedling <10cm cbh (Saxena*et al*., 1984). The shrubs, herbs and seedling were analyzed by sampling of 5×5m and 1×1m quadrats, respectively for each forest. The abundance to frequency ratio was studied for eliciting their distribution patterns. This ratio indicates regular (<0.025), random (0.025-0.05) and contagious (>0.05) distribution of species (Curtis &Cottom, 1956).

The floral diversity and concentration of dominance was calculated by Simpson's index (Simpson, 1949) as:

$$Cd=\sum (ni/n)\ 2.$$

Where, n is the total number of species and ni is individuals of a species.

Results and Discussion

A total of 56 plant species were recorded from the study area out of which 19 were tree, 10 were shrubs and 27 were herbs. Total species diversity is greater in mixed broad leaved forest (forest type-1) than pine forest (forest type-2). The results indicated that species diversity decreased in pine forest than mixed broad leaved forest as shown in Table 1, 2, 3 & 4.In forest type-1 it was shown greater diversity of trees, shrubs and herbs than forest type-2 (Table 1, 3 & 4) by Simpson index. In forest type-1 tree diversity in sapling as well as seedling was higher than forest type 2. Herbs and shrubs diversity was also observed higher in forest type-1 than forest type-2 as shown in Table 1,2,3&4.

Tree

In forest type-1 *Acacia modesta* and *Pinusroxburghii* was dominant species of forest type -1(IVI= 52.88 & 68.84, respectively) followed by *Dalbergiasissoo*, *Mallotusphilippensis, Oleacuspidata, etc*.(IVI=35.02, 31.77, 22.55, respectively)and the lowest dominant species was *Ficuspalmata* (IVI=4.43). While in forest type -2 *Pinusroxburghii* was the dominant one (IVI=180.35) followed by *Mallotusphilippensis, Pistaciaintegerrima, Terminaliachebula, Phyllanthusemblica, Terminaliabellirica* (IVI=24.52, 17.27, 11.89) and the lowest dominant was *Ficusroxburghii*(IVI= 4.97) Table -2.

Sapling

In forest type-1 *Acacia modesta* was the dominant species (IVI=73.44) followed by *Mallotusphilippensis,Oleacuspidata, Pinusroxburghii*(IVI=46.93, 39.86, 31.01, respectively) and in forest type-2 *Pinusroxburghii* was the dominant species (IVI=110.30) followed by *Phyllanthusemblica, Mallotusphilippensis, Terminaliabellirica, Grewiavestita* (IVI=34.11, 33.17, 27.28, 22.12, respectively).

Seedling

Higher diversity of seedling was shown by *Mallotusphilippensis* (IVI=101.22) in forest type-1 followed by *Pyruspashia, Acacia modesta, cassia fistula* (IVI=72, 39.21, 31.55, respectively) and in forest type-2 *Pinusroxburghii* was the dominant

Table-1 Diversity, distribution patterns and regeneration status of forest type-1(Broad leaed forest)

	Tree			Sapling			Seedling		
Name of Species	**A/F Ratio**	**IVI**	**Simpson index**	**A/F Ratio**	**IVI**	**Simpson index**	**A/F Ratio**	**IVI**	**Simpson index**
Dalbergiasissoo	0.032	35.02	0.01	0.000	0.00	0.00	0.100	8.61	0.00
Pyruspashia	0.100	4.52	0.00	0.050	18.44	0.00	0.069	72.00	0.06
Oleacuspidata	0.044	22.55	0.01	0.067	39.86	0.02	0.000	0.00	0.00
Toonaciliata	0.075	14.44	0.00	0.000	0.00	0.00	0.000	0.00	0.00
Acacia modesta	0.072	52.88	0.00	0.052	73.44	0.06	0.078	39.21	0.00
Ficuspalmata	0.100	4.43	0.00	0.100	9.55	0.00	0.000	0.00	0.02
Pinusroxburghii	0.084	68.84	0.05	0.150	31.01	0.01	0.044	29.90	0.00
Mallotusphilippensis	0.063	31.77	0.01	0.078	46.93	0.02	0.039	101.22	0.01
Cassia fistula	0.200	7.43	0.00	0.075	21.01	0.00	0.044	31.55	0.11
Syzygiumcumini	0.056	18.70	0.00	0.125	29.54	0.01	0.400	17.50	0.01
Flacourtiaramontchi	0.100	4.54	0.00	0.100	9.22	0.00	0.000	0.00	0.00
Phyllanthusemblica	0.075	11.70	0.00	0.000	0.00	0.00	0.000	0.00	0.00
Ficusroxburghii	0.050	9.59	0.00	0.000	0.00	0.00	0.000	0.00	0.00
Grewiavestita	0.100	13.58	0.00	0.000	0.00	0.00	0.000	0.00	0.00
Euphorbia royleana	0.000	0.00	0.00	0.075	21.01	0.02	0.000	0.00	0.00
		299.99	0.096		300.01	0.14		299.99	0.21

A/F= Abundance/Frequency ratio, IVI= Importance Value Index

species (IVI=64.85) followed by *Terminalia bellirica, Mallotus philippensis* (IVI=41.50, 40.84).

Shrubs

It has been noticed that diversity of shrubs was decreased in pine dominating forest. In forest type-1 *Carissa spinarum* was the dominant species(IVI=120.51) and *Woodfordiafruticosa* IVI=181.07) was the dominant species of forest type-2 (Table-3).

Herbs

Diversity of herbs was also shown decreasing trend in pine dominating forest as shown in Table-4. In forest type-1 *Cynodondactylon* (IVI=31.87) and in forest type -2 *Bidenspilosa* was the dominant species.

The vegetation of Nowshera block was very diverse and similar to other Indian Himalayan forests. The geographical location, climate and topography ofthe block have contributed to its characteristic vegetation and flora.

Forest type-1 showed the highest species diversity followed by forest type-2. Forest type -1 showed greater shrubs and herbs diversity. Shrubs and herbs diversity decreased in pure pine forest and it may be due to anthropological disturbances in these types of forest. Rathore (1993) noticed high species richness and diversity in *Pinusroxburghii*-mixed broad leaved forest. Bruns,(1995) and Austin *et al*., (1996) analyzed association between species richness and climate, slope position and soil nutrient status and found that that total species diversity was greater in low elevations, warm site with moderate rainfall and intermediate to high nutrient level.

Table-2Diversity, distribution patterns and regeneration status of forest type-2(Pure pine forest)

	Tree			Sapling			Seedling		
Name of Species	**A/F Ratio**	**IVI**	**Simpson index**	**A/F Ratio**	**IVI**	**Simpson index**	**A/F Ratio**	**IVI**	**Simpson index**
Pinusroxburghii	0.079	180.55	0.36	0.058	110.30	0.14	0.022	64.85	0.05
Mallotusphilippensis	0.089	24.52	0.01	0.067	33.17	0.01	0.078	40.84	0.02
Grewiavestita	0.200	6.34	0.00	0.125	27.28	0.01	0.300	17.96	0.00
Cassia fistula	0.000	7.99	0.00	0.000	0.00	0.00	0.100	8.03	0.00
Phyllanthusemblica	0.100	13.10	0.00	0.067	34.11	0.01	0.044	38.65	0.02
Terminaliabellirica	0.075	11.89	0.00	0.200	12.00	0.00	0.031	41.50	0.02
Termenaliachebula	0.033	15.99	0.00	0.033	22.12	0.01	0.044	36.57	0.02
Pistaciaintegerrima	0.033	17.27	0.01	0.050	14.90	0.00	0.050	18.14	0.00
Ficuspalmata	0.050	10.94	0.00	0.050	15.69	0.00	0.100	10.62	0.00
Ficusroxburghii	0.100	4.97	0.00	0.050	14.90	0.00	0.200	14.29	0.00
Pyruspashia	0.200	6.44	0.00	0.050	15.53	0.00	0.100	8.55	0.00
		300.00	0.38		300.00	0.18		300.00	0.13

A/F= Abundance/Frequency ratio, IVI= Importance Value Index

Table-3 Diversity and distribution patterns of shrubs in forest type -1 and forest type-2

Shrubs	**Forest type-1**			**Forest type-2**		
Name of Species	**A/F Ratio**	**IVI**	**Simpson index**	**A/F Ratio**	**IVI**	**Simpson index**
Justiciaadhotoda	0.214	71.77	0.06	0.000	0.00	0.00
Dodonaeaviscosa	0.150	26.84	0.01	0.000	0.00	0.00
Carissa spinarum	0.110	120.51	0.16	0.250	76.83	0.07
Myrsineafricana	0.100	8.35	0.00	0.000	0.00	0.00
Neriumindicum	0.700	7.60	0.00	0.000	0.00	0.00
Ziziphusmaurtiana	0.300	5.49	0.00	0.200	24.93	0.01
Calotropisprocera	0.063	19.08	0.00	0.000	0.00	0.00
Ipomoea carnea	0.322	25.67	0.01	0.000	0.00	0.00
Woodfordiafruticosa	0.250	14.68	0.00	0.138	181.07	0.36
Randiatetrasperma	0.000	0.00	0.00	0.100	17.17	0.00
		299.99	0.24		300.00	0.44

A/F= Abundance/Frequency ratio, IVI= Importance Value Index

Table 4 –Diversity and distribution pattern of herbs

Herbs	Forest type-1			Forest type-2		
Name of Species	A/F Ratio	IVI	Simpson index	A/F Ratio	IVI	Simpson index
Cenchrusciliaris	0.000	0.00	0.00	0.875	8.71	0.00
Paspalidiumflavidum	0.100	4.96	0.00	0.175	25.69	0.01
Setariagluca	0.408	17.25	0.01	0.450	17.71	0.00
S. sphacelta	0.756	10.22	0.00	0.000	0.00	0.00
Chrysopogonfulvus	0.867	16.88	0.01	0.425	21.29	0.01
Echinochloacolona	1.389	20.05	0.00	0.344	23.63	0.01
Eriophorumcomosum	1.925	15.06	0.00	1.111	26.26	0.01
Cyprus niveus	0.000	0.00	0.00	0.825	26.62	0.01
Cynodondactylon	0.924	31.87	0.01	0.648	35.32	0.01
Bidenspilosa	0.506	17.47	0.00	2.100	47.85	0.03
Circiumarvense	0.163	9.89	0.00	0.100	7.84	0.00
Conyzaambigua	0.522	10.91	0.00	0.100	4.66	0.00
C. bonariensis	1.425	10.99	0.00	0.000	0.00	0.00
Partheniumhysterophorus	0.569	24.46	0.01	0.156	11.43	0.00
Silybummarianum	0.300	7.00	0.00	0.350	6.66	0.00
Sonchusasper	0.119	7.45	0.00	0.067	6.98	0.00
Taraxacumofficinale	0.069	7.17	0.00	0.050	4.17	0.00
Achyranthesaspera	0.324	18.07	0.01	0.325	7.44	0.00
Amaranthusspinosus	0.081	10.49	0.00	0.000	0.00	0.00
A. viridis	0.084	10.83	0.00	0.000	0.00	0.00
Capsella bursa-pastoris	0.100	2.88	0.00	0.075	4.23	0.00
Cassia occidentalis	0.225	9.10	0.00	0.575	9.04	0.00
Sileneconoidea	0.260	16.05	0.00	1.200	4.46	0.00
Oxalis corniculata	0.875	8.09	0.00	0.000	0.00	0.00
Cassia tora	0.475	4.68	0.00	0.000	0.00	0.00
Sidacordifolia	0.150	3.15	0.00	0.000	0.00	0.00
Malvastrumcoromandelianum	0.111	5.00	0.00	0.000	0.00	0.00
		299.97	0.05		299.99	0.09

A/F= Abundance/Frequency ratio, IVI= Importance Value Index

The communities which were present in the forest type -1, was dominated by *Acacia modesta* and under shrubs layer by *Euphorbia royleana, Carissa spinarum, Dodonaeaviscosa, etc.* Champion *et al.,* (1965) also mentioned it as plain thorn forest which may also ascends up to subtropical forest. *Pinusroxburghii* was the dominant tree species of forest type -2 and it also showed some dominancy in forest type-1.The recorded species diversity value 0.096-0.38 is very low for Himalayan range (Pande, 2001; Mishra *et al.,* 2003. Sharma *et al.,* 2009). A slow rate of evolution of community and relatively drier climatic conditions can also responsible for low diversity value of subtropical forest as compared to high diverse tropical forest and temperate vegetation (Conell and Oris, 1964).

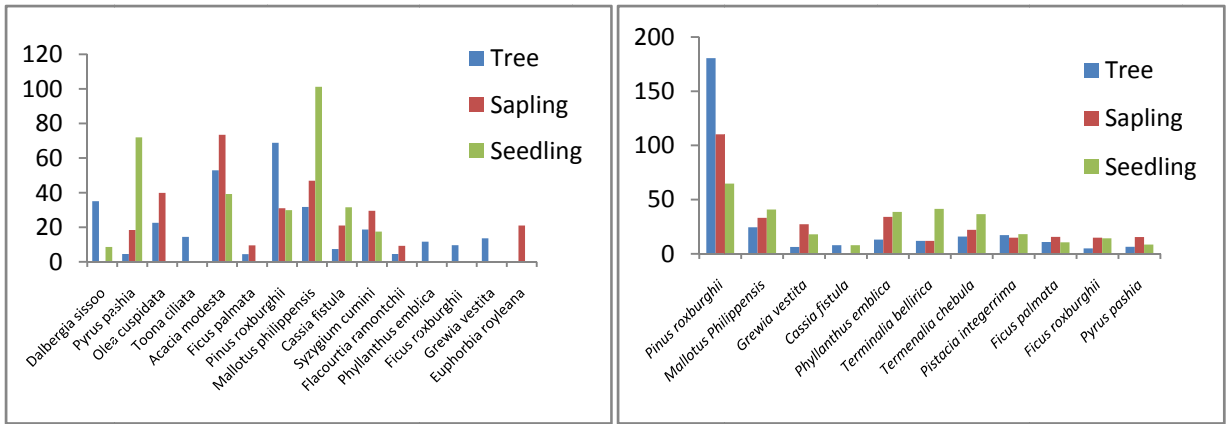

Fig.-1 Regeneration and diversity of tree in forest type-1Fig. -2 Regeneration status and diversity of forest type -2.

The regeneration status of trees in both the sites (Forest type-1 & 2**)** was studied by using following Koul*et al.*, 2008.). Good regeneration; if Seedling>Sapling>Adults; Fair regeneration, if Seedling > or ≤ Sapling ≤ Adults; poor regeneration if only by Sapling are present but no Seedlings. If only adult trees are present, it is considered as no regeneration. Inforest type-1of study area*Mallotusphilippensis* had good regeneration and *Acacia modesta*showed fair regeneration, while *Pinusroxburghii*exhibited poor regeneration in forest type-1. Some species of forest type-1 had poor regeneration while other showed no regeneration (Table:1,2& Fig.1&2.). In forest type -2 *Pinusroxburghii*had fair regeneration. The plants like*Mallotusphilippensis,Grewia, Terminalia*showed new regeneration (only Seedling and Sapling were reported from the study area and very rare adult plant).In the study area, most of the trees species exhibited contagious distribution. But species like *Dalbergiasissoo and Mallotusphilippensis* showedrandom and regular distribution in forest type-1. Most of shrubs and herbs showed contagious distribution in each forest type. (Table 1, 2,3&4).The high intensity of anthropological disturbances regularly disturbs the natural balance of forest community, thus preventing them to reach climax stage of community maturity (Saxena*et al.*, 1984). This phenomenon is evident from heavy grazing and tree felling in study sites and also collection of lower plants for other proposes such as medicinal importance. Consequently the grazing pressure shift to the surrounding forest reserves, creating a massive stress on the forest ground flora, shrubs and most important the seedling (Negi, 2009).

Conclusion

Hence, we may conclude that the study area needs a complete protection from biotic interferences, deforestation, grazing and human activities so that the natural vegetation may come up again. The Forest Department should take active action against the local inhabitants who are involved in cutting of forest for earning their livelihood.

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