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Ecological variation among natural populations of *Terminalia chebula* Retz in Sirmour and Una districts, Himachal Pradesh

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ABSTRACT

The present study was confined to two natural populations of *Terminalia chebula* Retz distributed in Sirmour and Una districts of Himachal Pradesh. In every natural population 5 quadrats of 30 x 30 m (900 sqm) size determined by species area curve method were randomly laid to study tree species. In each quadrat, a sub-quadrat of 5 x 5 m (25 sqm) size was selected for study of shrubs. Among trees *T chebula* was dominant tree species in Jamun Ki Sair and Ghanu with IVI value of 109.01 and 78.36 respectively. Among shrubs *Murraya koengii* was dominant species in both the populations having IVI value of 127.74 in Jamun ki Sair and 76.10 in Ghanu. Population-wise species diversity in trees ranged from 2.8 to 2.16, species dominance from 0.75 to 0.80, species richness from 2.67 to 3.12 and equitability from 0.77 to 0.82. Species diversity in shrubs ranged from 1.31 to 2.01, species dominance from 0.80 to 0.84, species richness from 0.72 to 1.84 and equitability from 0.92 to 0.94.

Keywords*:* Natural population; phytosociology; importance value index; dominance; equitability

INTRODUCTION

The genus *Terminalia* includes about 200 species of trees and shrubs distributed in the tropical and subtropical regions of the world. In India 20 species belonging to four sections namely *Catappa*, *Myrobalanus*, *Chuncea* and *Pentaptera* have been reported to be distributed in the tropical and subtropical states. *Terminalia chebula* Retz commonly known as Harar belongs to family Combretaceae and is indigenous to India and southeast Asia (Dymock et al 1976). In India it is distributed throughout the greater part except arid zone (Troup 1921). It is found in sub-Himalayan tract from the Ravi eastward to West Bengal and Assam ascending up to an altitude of 1600 m. The structural analysis of vegetation entails the floristic composition, stand density, basal area, vertical stratification and community types while diversity provides information on species richness, distribution and rate

of change in species composition. Both structure and diversity of vegetation have strong functional role in controlling ecosystem processes like biomass production, cycling of water and nutrients (Gower et al 1992). The structural attributes of plant community can be expressed both in qualitative and quantitative characters. The qualitative characters are physiognomy, stratification, abundance, dispersion, sociability, vitality and life form whereas quantitative characters include density, frequency, dominance and basal area (Odum 1983). These quantitative primary variables are used for deriving secondary variable and importance value index (IVI) of a species in a given community. Harar is naturally found as a component of mixed forests. The study of its interaction and prevalence in a community is important with respect to its conservation. The natural populations of *T chebula* in Himachal Pradesh are only confined to few patches predominantly in Lower or Shivalik Chir pine forests type/sub-type 9/C_{1a} in Himachal Pradesh where top storey of forest is occupied by *Pinus roxburghii* and *T chebula* and other associate tree species. An extensive search of literature failed to reveal any useful information on phytosociology of *T chebula.* Keeping in view the socio- economic importance of the species the present investigation was carried out with objective to study the distribution pattern and ecological status of *T chebula* Retz at two locations in Sirmour and Una districts of Himachal Pradesh.

METHODOLOGY

The present study was confined to two natural populations of *T chebula* Retz distributed in district Sirmour and Una districts of Himachal Pradesh. The physical description of natural populations is given in Table 1. The climate of study sites was sub-tropical with cold winters. The temperature went up to a maximum of 41.5°C in summer and minimum of 4.6°C in winter and rainfall was received in monsoon. The rainfall pattern was typical monsoon type with rainfall concentrated from July to September. To study the status of plant diversity at each population, community analysis was carried out during rainy season when majority of the plants were at the peak of their growth. In every natural population five quadrats of 30 x 30 m (900 sqm) size determined by species area curve method were randomly laid to study tree species. In each quadrat, a sub-quadrat of 5 x 5 m (25 sqm) size for shrubs was selected. Density of trees was calculated by counting trees in each sample plot. Basal area of each tree in the sample plot was determined by tree calliper. Density of shrubs was calculated by counting plants of different species in each sub-plot. The basal area of shrubs was calculated by using digital calliper. Each species was analyzed quantitatively for various parameters viz basal area, density and frequency. The field work was carried out within two years from 2011 to 2013. The vegetation data were quantitatively analyzed for density, per cent

frequency and abundance. Relative frequency, relative density and relative basal area were determined following Phillips (1959) while importance value index (IVI) was calculated following Mishra (1989). The species richness was calculated by using 'Margalef's index of richness' (D_{mg}) (Magurran 1988). Species diversity, dominance and equitability were evaluated by following Shannon-Wiener index of diversity (Shannon and Wiener 1963), Simpson index of dominance (Simpson 1949) and Pielou equitability (e) (Pielou 1975) methods respectively.

RESULTS and DISCUSSION

The tree species that occurred in two natural populations of *T chebula* Retz are presented in Table 2. There were 15 and 14 tree species in Jamun Ki Sair and Ghanu respectively in natural populations of *T chebula*. Table 3 reveals the floristic composition of shrubs in natural populations of *T chebula*. There were 4 and 9 shrub species in Jamun Ki Sair and Ghanu respectively. In Jamun Ki Sair *T chebul*a was dominant species with IVI value of 109.01and *P roxburghii* was co-dominant tree species having IVI of 64.97. *Murraya koenigii* was dominant shrub species with IVI of 127.74 followed by *Adhatoda vasica* with IVI of 65.75 (Table 4). In Ghanu also *T chebul*a was dominant tree species with IVI value of 78.36 followed by *Mallotus philippinensis* as co-dominant tree species with IVI value of 57.66. *Murraya koengii* was dominant shrub species with IVI value 76.10 while *Lantana camara* was co-dominant having IVI of 63.73 (Table 5). The tree species diversity was 2.08 in Jamun Ki Sair and 2.16 in Ghanu while shrub species diversity was 1.31 and 2.01 respectively. In Jamun Ki Sair values for tree species dominance, species richness and equitability were 0.80, 3.12 and 0.77 respectively and values for shrub species dominance, species richness and equitability were 0.80, 0.72 and 0.94 respectively. In Ghanu values for tree species dominance, species richness and equitability were 0.75, 2.67 and 0.0.82 respectively and values for shrub species dominance, species richness and equitability were 0.84, 1.84 and 0.92 respectively (Table 6). This distribution pattern of basal area in different forest communities may be attributed to the dominance of one species over other species in their respective habitat. In general Harar and Chir pine had older crop in their habitat. The higher density of shrubs may be explained on account of

Table 1. Physical description of sites (populations)

Location	District	Population code	Altitude (m)	Latitude (N)	Longitude (E)
Jamun Ki Sair	Sirmour	JKS	1050	30°41´733´´	77° 10´611´´
Ghanu	Una	GHN	590	31° 48´486´´	75° 57´354´´

Table 2. Floristic composition of trees in natural populations of *Terminalia chebula*

Species	Jamun Ki Sair	Ghanu
Acacia catechu	+	+
Aegle marmelos	+	-
Bauhinia variegata	-	+
Bombax ceiba	+	+
Butea monosperma	+	-
Cassia fistula	+	-
Celtis australis	-	+
Emblica officinalis	+	+
Ficus Bengalensis	+	-
F religiosa	+	-
Grewia optiva	-	+
Lannae coromandelica	+	-
Mallotus philippinensis	+	+
Mangifera indica	-	+
Phoenix sylvestris	-	+
Pinus roxburghii	+	+
Pyrus pashia	+	-
Syzygium cuminii	+	+
Terminalia bellirica	+	+
T chebula	+	+
Toona ciliata	-	+
Total	15	14

(+)= Present, (-)= Absent

Table 3. Floristic composition of shrubs in natural populations of *Terminalia chebula*

Species	Jamun Ki Sair	Ghanu
Carrisa opaca	+	+
Myrsine africana	-	+
Murraya koenigii	+	+
Rubus ellipticus	-	+
Woodfordia fruticosa	-	+
Indigofera pulchella	-	+
Colebrookea oppositifolia	-	+
Adhatoda vasica	+	+
Lantana camara	+	+
Total	4	9

(+)= Present, (-)= Absent

Table 4. Density, basal area, per cent frequency and IVI of trees and shrubs in Jamun Ki Sair

Species	Density (individuals/ha)	Abundance (AB)	Basal area		Per cent frequency	IVI
			Trees (m^2/ha)	Shrubs (cm^2/ha)		
Tree						
Acacia catechu	2	1	0.02	-	20	4.98
Aegle marmelos	2	1	0.03	-	20	5.03
Bombax ceiba	4	2	0.23	-	20	7.59
Butea monosperma	2	1	0.04	-	20	5.08
Cassia fistula	7	1.5	0.05	-	40	11.09
Emblica officinalis	7	1	0.29	-	60	16.48
Ficus Bengalensis	2	1	0.35	-	20	7.25
F religiosa	2	1	0.19	-	20	6.14
Lannae coromandelica	4	2	0.37	-	20	8.55
Mallotus philippinensis	13	3	0.48	-	40	17.51
Pinus roxburghii	44	5	3.96	-	80	64.97
Pyrus pashia	13	6	0.18	-	20	11.67
Syzygium cuminii	2	1	0.09	-	20	5.43
Terminalia bellirica	13	3	0.72	-	40	19.21
T chebula	78	7	7.32	-	100	109.01
Total	195	36.5	14.3	-	540	300.00
Shrub						
Adhatoda vasica	1280	8	-	1027.33	40	65.75
Carrisa opaca	800	3.33	-	480.92	60	51.9
Lantana camara	1120	7	-	684.91	40	54.6
Murraya koenigii	1920	4.8	-	2071.85	100	127.74
Total	5120	23.13	-	4265.02	240	300.00

more space and less tree cover allowing more shrubs to grow on the surface floor. Singh et al (1994) have reported density value ranging between 250-2070 trees/ha and shrub density between 1460-1660 shrubs/ha for different central Himalayan forests. The higher basal area denotes the presence of higher number of mature trees and shrubs in natural populations. These values were quite lower than the values reported by Kumar and Bhatt (2006) to subtropical forests of Garhwal Himalaya.

The present study confirms that natural populations of *T chebula* consist of thickly populated village and each village

Table 5.Density, basal area, per cent frequency and IVI of trees and shrubs in Ghanu

Species	Density (individuals/ha)	Abundance (AB)	Basal area frequency		Percentage	IVI
			Trees (m^2/ha)	Shrubs (cm^2/ha)		
Tree						
Acacia catechu	27	2.4	0.34	-	100	24.45
Bauhinia variegate	2	1	0.09	-	20	3.92
Bombax ceiba	27	2.4	2.9	-	100	39.83
Celtis australis	4	1	0.46	-	40	9.56
Emblica officinalis	2	1	0.06	-	20	3.78
Grewia optiva	2	1	0.19	-	20	4.53
Mallotus philippinensis	111	10	1	-	100	57.66
Mangifera indica	4	1	0.67	-	40	10.83
Phoenix sylvestris	2	1	0.01	-	20	3.47
Pinus roxburghii	24	2.75	2.99	-	80	36.99
Syzygium cuminii	7	1	0.4	-	60	12.59
Terminalia bellirica	2	1	0.21	-	20	4.69
T chebula	69	6.2	6.87	-	100	78.36
Toona ciliata	4	1	0.42	-	40	9.34
Total	287	32.75	16.61	-	760	300.00
Shrub						
Adhatoda vasica	560	2.33	-	287.02	60	33.68
Carrisa opaca	720	4.5	-	156.72	40	26.37
Colebrookea oppositifolia	640	2.67	-	255.47	60	33.47
Indigofera pulchella	240	1.5	-	95.61	40	15.78
Lantana camara	1280	3.2	-	521.54	100	63.73
Murraya koenigii	2080	5.2	-	511.89	100	76.1
Myrsine africana	320	2	-	75.91	40	16.13
Rubus ellipticus	320	1	-	135.34	80	26.35
Woodfordia fruticosa	80	1	-	71.9	20	8.39
Total	6240	23.4	-	2111.42	540	300.00

exploits forest resources for its basic needs from these forests (Kumar and Bhatt 2006). Similar results have been obtained during the studies in similar ecosystems by Sharma and Kant (2014), Kumar and Bhatt (2006), Tripathi et al (2010) and Jahangir (2004). The distribution of Harar and Chir pine was very narrow and the patches were more or less exposed to southern aspect which being dry exposed these stands to intense and frequent forest fires which is in conformity to other similar investigations of Jhangir (2004) and Sharma et al (2009). The recorded

Table 6. Vegetation indices of trees and shrubs under natural populations of *Terminalia chebula*

Location	Plant category	Vegetation index			
		Shannon-Wiener Index	Simpson's Dominance	Species Richness	Equitability (e)
Jamun Ki Sair	Trees	2.08	0.8	3.12	0.77
	Shrubs	1.31	0.8	0.72	0.94
Ghanu	Trees	2.16	0.75	2.67	0.82
	Shrubs	2.01	0.84	1.84	0.92

diversity indices values lied within the limits as reported by Pandey (2001) and Kumar et al (2010).

CONCLUSION

Due to over-exploitation and illicit felling as well as ruthless exploitation most of the valuable species are either disappearing or rarely available. Fragmentation of natural forest due to anthropogenic pressure is a common phenomenon. Disproportionate growth in human and livestock population over the last few decades is posing significant threat to these populations. The present study confirms moderate degree of disturbance in Shivalik Chir pine forests having *Terminalia chebula* as dominant species.

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