ORIGINAL RESEARCH PAPER

Forestry

Studies on species richness, diversity and regeneration status of *Shorea robusta* in tropical deciduous forest of sub humid tropical forest of Central India.

KEY WORDS: regeneration status, *Shorea robusta*, species richness, diversity

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ABSTRACT

The regeneration study of *Shorea robusta* Gaertn.F. in the tropical deciduous forest of Achanakmar was carried out during 2013-2015. The study area was the natural forest where *Shorea robusta* was dominant species. This paper reports the status of Sal in two forest sites namely undisturbed and disturbed forest sites in Achanakmar Amarkantak Biosphere Reserve. In general, both forest sites were regenerating although seedling and sapling population was higher in undisturbed forest site. The density and diversity was reported more in the undisturbed sites as compared to disturbed sites where as species richness was reported more in disturbed sites than in undisturbed sites. The result indicates that anthropogenic disturbance is more in buffer forest sites which may have affected the forest composition. The proper forest management and rehabilitation activities may be able to restore the climatic conditions of the degraded forest area and thus may result in the better regeneration.

Introduction:

Shorea robusta Gaertn.F is an important timber yielding tree (Basyal et. al., 2011) and is of great profitable value. It is considered as the climax species in various zones. The leaves of Sal tree also acts as an important source of non- timber forest products(Dekh et al. 2012). Sal forests cover 10.57 million ha to 13 10.57 million in India (Rathore, 2000; Sapkota 2009 and Dekh et al. 2012). Sal forests can be either 'moist' or 'dry' depending on the annual rainfall and the soil moisture status (Champion & Seth, 1968; and Shankar, 2001).The Sal forest of Bilaspur forest division Chhattisgarh is located in central part of India, among the important heritage site of natural forest. The forest has a rich, complex and varieties of flora and fauna. The Chhattisgarh forest flora includes Sal, Teak, Mixed and Bamboo breaks as the predominant forest types. However, during last few decades, these forests are subjected to various anthropogenic disturbance including abiotic and biotic factors (Sahu et al, 2008; Singh et al, 2010; and Bhattarai and Mandal, 2012). Although an appreciable number of studies on Sal dominated forests are already available, still there is a need of latest inventory (Tripathi and Shankar, 2014). Therefore, the present study was aimed to understand the effect of such disturbances on regeneration status of Shorea robusta in tropical deciduous Sal forest in Bilaspur forest division, Chhattisgarh.

METHODOLOGY

The Achanakmar Amarkantak Biosphere Reserve was notified as 14th Biosphere Reserve in India by Government of India on 30 March 2005. The Biosphere Reserve spreads from Mikal hill ranges to Vindhyan and Satpura hill ranges which form the triangular shape in Chhattisgarh and Madhya Pradesh states of India. The Biosphere Reserve lies between the parallels of latitude 21° 15'-22° 58'N and 81° 25' to 82° 5' E longitude. The study was conducted in the natural Sal forest area situated in Achanakmar. December and January are the coldest months and May is the hottest month. The mean temperature is 21°C -33°C and the area experiences pre-monsoon showers at the end of May and monsoon from July to August. The average annual rainfall is about 1,900 mm and is received largely from South-West monsoon (Singh et. al., 2010). The soil was laterite, red to brownish in colour with loamy clayey texture in both undisturbed and disturbed forest stand. The pH of soil sample of the study area ranged from 5.7 to 6.4 indicating the soil existence is acidic in nature. To study the regeneration pattern and species composition different quadrates were laid down on the forest floor during the study period in both undisturbed and disturbed area. The tree was analyzed by randomly placing twenty quadrats of 10m x 10m in size on each site. Girth at breast height (i.e. 1.37m above ground) of all the trees in each quadrat was measured and recorded individually within each quadrat and sub-quadrats of 2mx 2m was used for measuring seedling. The vegetation data was quantitatively analyzed for density and frequency (Curtis and McIntosh 1950). The diversity was determined by using Shannon-Weiner index (Shannon and weaver 1963), as $H' = - \sum si=1(Pi) (\log 10Pi)$, Equitability (e) was calculated following pielou (1966), as $E = H'/ S$, Species richness (d) was calculated following Marglef (1958) as $D = (S-1)/ N$, similarity index(S) is calculated according to Czekanowski index (1913), beta diversity was calculated following Whittaker (1972) as $\beta d = Sc/ S$.

Result and discussions:

The study area shows the uniform distribution of different plant species. There was much difference in anthropogenic or biotic pressure in the different sites of the study area. The area having such disturbances is selected as disturbed area and other having least such disturbances is selected as the undisturbed area from the study sites. Variation in tree density and distribution of tree species on these two selected sites in the forest indicates the complex succession resulting from varying degree of biotic pressures on these two sites. The total numbers of 32 plant species belonging to varied families (20) with different habits were recorded.

Shorea robusta belonging to family depterocarpaceae is the dominant forest tree species in both the forest stand of the study area as the locality factors may be most suitable for the species. Occasionally maximum plant species were recorded from Fabaceae family and another family with the higher number of species includes Euphorbiaceae and Combretaceae. Along with Shorea robusta Species like Terminalia tementosa, Pterocarpus marsupium, Adina cordifolia, Anogisus latifolia, Bahunia lanzan, Aegle marmelos, Casearia graveolens, Bahunia variegate, Diospyros melanoxylon, are the important part of the floristic composition of the study area. The total numbers of 26 tree species belonging to varied families (16) were found in undisturbed forest sites where as the total numbers of 26 tree species belonging to varied families (17) was found in disturbed forest sites. The total numbers of 20 sapling species belonging to varied families (14) were found in undisturbed forest sites where as the total numbers of 22 sapling species belonging to varied families (15) was found in undisturbed forest sites. The total numbers of 18 seedling species belonging to varied families (14) were found in undisturbed forest sites where as the total numbers of 19 seedling tree species belonging to varied families (16) was found in undisturbed forest sites. The studies of tree density and frequency distribution can contribute to understand the structure of tropical forests (Jayakumar and Nair, 2013). The total density in both the forest sites varied significantly and it was higher (18.3 plants/100 sq. m), (17.9plants/100 sq. m), (28.6 plants/100 sq. m) in undisturbed forest stand than (13.6 plants/100 sq. m), (13.4 plants/100 sq. m), (21.8 plants/100 sq. m) in disturbed forest stand for trees, saplings, and seedlings respectively. The frequency for Shorea robusta was noticed 100% in both the study stands.

The density, diameter, and distribution of tree species was directly correlated with the age and structure of the forest stand by Chauhan et. al.,(2014). The density of higher diameter class was found low in both forest sites and the similar observation was noticed by Chauhan et. al.,(2014). According to the study carried by Chauhan et. al.,(2014), the two significant factors which are responsible for high anthropogenic disturbances in the forest are easy approaches and high plant biodiversity. The low density of tree species in disturbed forest sites is may be due to anthropogenic disturbances like extraction of timber, the collection of nonwood forest produces, and damage of plant species by wild animals like pig, deer, bison etc. Kumar and Sharma (2014) have found in their study that the low density of tree species in disturbed forest area is due to extraction of forest produces by local human population for their utilization for timber, fuel wood, and fodder. Shorea robusta was found to be first in species ranking in both the disturbed and undisturbed forest stand of the study area and which was found to lose its density with the disturbance underneath all the growth stages i.e. tree, sapling, and seedling. The similar finding was also observed by Chauhan et. al., (2014) that the density values decreased with the increasing intensity of disturbances for tree, sapling, and seedling. Shrestha et al. (2000) have also reported that the natural and regenerating forest sites have higher tree density in comparison to the degraded forest site.

Table1: Species diversity underneath different growth stages of Undisturbed and Disturbed forest stands.

Community statics'	Symbol /unit	Growth stages	Undisturbed	Disturbed
Shannon-wiener Index	H'	Tree	3.522	2.692
		Sapling	1.203	0.812
		Seedling	0.802	0.337
Simpson Index	Cd	Tree	5.056	3.293
		Sapling	0.196	0.057
		Seedling	0.101	0.051
Species richness	D	Tree	0.193	0.582
		Sapling	0.699	4.190
		Seedling	0.225	1.072
Equitability	e	Tree	0.135	0.103
		Sapling	0.601	0.036
		Seedling	0.045	0.017
β diversity	βd	Tree	3.93	5
		Sapling	3.88	4.95
		Seedling	3.83	3.93
Similarity Index	S	Tree	88.46 %	
		Sapling	85.46 %	
		Seedling	72.22 %	

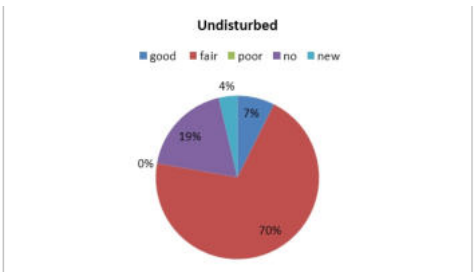

Fig.1.Regeneration status of Undisturbed forest stand.

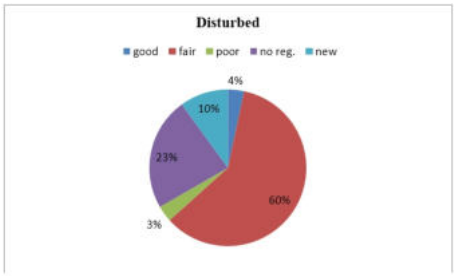

Fig. 2. Regeneration status of Disturbed forest stand.

The species diversity is influenced by a disturbance in landscape and therefore, for better understanding the interactions between spatial with disturbance pattern is required (Chauhan et. al., 2008). Diversity parameters in both the undisturbed and disturbed forest stands are summarized in the Table1. The variability was noticed in Shannon index at the two forest stands in the study area. The Shannon index was recorded was (3.523), (2.696), (1.203), (0.812), (0.802), and (0.337) for tree layers, sapling layers and seedling layers respectively in undisturbed forest stands and on disturbed forest stands. The concentration of dominance varied in undisturbed and disturbed forest stand and the value was (C3.293), (5.056), (0.196), (0.057) (0.101) (0.051) for different growth stages in undisturbed forest stand and disturbed forest stands respectively. The similarity index showed the high degree of similarity in forest stands and the observed values of similarity index were 88.46%, 85.71% and 72.22% for tree, sapling, and seedling respectively. The calculated values of species richness were (0.193), (0.582), (0.699), (4.190), (0.225) and (1.072) for tree stages, sapling stages and seedling stages respectively in undisturbed forest stand and disturbed forest stand. The equitability values was (0.135), (0.103), (0.601), (0.036), (0.045) and (0.017) in undisturbed and disturbed forest stand for different growth stages of tree, sapling, and seedling respectively.

The study of regeneration of forest trees has important implications for the management of natural forests. The regeneration in natural forest depends on various factors such as seed fall, seed viability, availability of nutrients and the microclimate (Macedo et. al., 2008). The present study provides quantitative information on the community structure and regeneration status of certain recorded species of the sites. The status of regeneration of species was determined on the basis of the population size of seedlings and saplings present in the study area. The regeneration status of a tree species in a given forest type was considered "good" when seedling > sapling > tree; fair regeneration if species present in seedling > or < sapling> or < tree; poor regeneration if a species survives only in sapling stage, but not as seedlings (saplings may be <, > or = trees) and if a species is present only in tree form it is considered as not regenerating. The species is considered as "new" if the species has no tree form but only seedling and saplings. If the species has no tree representatives but only sapling and seedling the species is also considered as not abundant (Sharkar, 2001). Regeneration status in undisturbed and disturbed forest stand has been shown in Fig 1 and 2. The regeneration status was calculated as 7%, 70%, 0%, 19%, and 4% for good regeneration, fair regeneration, poor regeneration, no regeneration and new species regeneration respectively in undisturbed forest stands. Whereas it was calculated as 4%, 60%, 3%, 23%, and 10% for good regeneration, fair regeneration, poor regeneration, no regeneration and new species regeneration respectively in disturbed forest stands. This may be existing due to the protection in undisturbed forest stand which leads to the positive effect on the establishment of plants. The protection of the area also helped in the regeneration of the species. The presence of the sufficient number of trees, saplings, and seedlings indicates a successful regeneration in protected core (undisturbed) region of Sal forest as compare to the buffer (disturbed) region of Sal forest.

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