

Impact of Biotic Pressure on Regeneration in Tropical Wet Evergreen Forests in Central Western Ghats



Forestry

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ABSTRACT

The present study was carried out in the tropical wet evergreen forest of Western Ghats region of Karnataka, which constitutes nearly 15 per cent tropical forests of the country. Totally 88 regeneration plots of 5 m X 5 m plot dimension were laid 250 m interval with in the belt transects of 1000 m X 5 m. In each plot the disturbance parameter were recorded and assigned a score for each disturbance parameter to calculate the cumulative disturbance index for each plot. Results of the study clearly showed a decrease in trend of regenerates of tree species and a reverse trend was observed for shrub and climber species. The regeneration of deciduous elements also increased with increase in disturbance. Higher disturbance has severely effected the regeneration of threatened and endemic tree species, indicating there is an urgent need to plan for the appropriate measure to overcome the problem.

Introduction:

Regeneration of any species is confined to a peculiar range of habitat conditions and the extent of those conditions is a major determinant of its geographic distribution [1]. The population structure of a species in a forest can convey its regeneration behaviour. The population structure is characterized by the presence of sufficient population of seedlings, saplings and adults, indicates successful regeneration of forest species [2], and the presence of saplings under the canopies of adult trees also indicates the future composition of a community [3]. Regeneration is the process of silvigenesis by which trees and forests survive over time [4]. The success or failure of regeneration of any species is governed by many factors, but there are very limited research has been carried out in the tropical wet evergreen forests particularly the biotic interferences such as grazing, cutting of trees, collection of litter, soil etc. This study is an attempt to understand the impact of biotic pressure on regeneration status, which would help in planning, conservation and decision making in forest resources management programmes.

Materials and methods:

The study was carried out in tropical wet evergreen forests in the Western Ghats region of Karnataka. It covers an area of about 20,000 sq. km and is a biodiversity rich region. The state has great diversity of climate, topography and soils. The tropical wet evergreen forests cover an area of 15 per cent (5,44,020 ha) of the region, representing the most luxuriant type of vegetation that can be seen along the Western Ghats belt, out of which about ten per cent of the forest can be grouped as closed forest with more than 80 per cent canopy cover [5].

The study was conducted from the year 2006-2009 in the tropical wet evergreen forests. The sampling was undertaken based on the methodology developed by Department of Biotechnology (DBT) sponsored project on 'Mapping and quantitative assessment of geographical distribution and population status of plant resources of Western Ghats' (DBT Grid method) [6]. That is the study area was divided into grids of 6.25 km² by using MapInfo software. In each grid a total area of 5000 m² was sampled using belt transects of 1000 meter length and 5 meter width. The 1000 meter belt transect was divided into two belt transects of 500 X 5 m depending on the heterogeneity of vegetation in the grid. Normalized Difference value Index (NDVI) was used ran-

dom placement of belt transects in the grid (Fig 2.). Smaller quadrates of 5 m² were laid at every 250 m. interval for regeneration studies. Totally 88 such regeneration plots were laid and the regenerates enumerated were grouped into four regeneration classes viz., Class I – up to 40 cm height, Class II – 40-100 cm height, Class III – more than 100 cm height and less than 10 cm gbh (girth at breast height 1.37 m.) and Class IV – more than 100 cm height and 10-30 cm gbh. The data was used to compute, species richness (Menhinick's index) diversity (Shannon's diversity), impact if disturbance on regeneration of tree species, threatened and endemic tree species, regeneration of different life forms etc. and was subjected to chi-square test to know the level of significance.

Results and discussion:

Cumulative Disturbance Index for evergreen forest sites

Various disturbance parameters, viz., Lopping, cut stumps, removal of soil, litter, intensity of grazing and per cent weed cover were used to computing Cumulative Disturbance Index, each disturbance parameter has been assigned with a score and based on which Cumulative Disturbance Index was calculated Table 1. These disturbance gradients were used to know their impact on the regeneration. Similar techniques have been used to know the effect of disturbance on regeneration in the sacred forests and the adjoining reserve forests [7].

The disturbances in forests have a negative impact, disrupting the climax and making it unsuitable for pioneering species [8]. Similarly in the wet evergreen forest of Central Western Ghats also the disturbance had influenced negatively on the regeneration by having very few regenerates in highly disturbed sites, while the moderate disturbance did not show any negative influence on regeneration.

Richness of regenerates as indicated by Mergalef's index decreased from undisturbed (15.95) to highly disturbed (3.37) areas. Diversity of regenerates as indicated by Shannon's diversity and Avalanche index was also higher in undisturbed areas (3.58 and 1.73 respectively) and was very poor in highly disturbed areas (Table 2.) The higher richness and diversity of regenerates could be due to fact that, mild disturbances accompanied with light canopy opening in undisturbed areas might have promoted regeneration rather than fully dense of highly disturbed forest

condition [7].

Association of disturbance with regeneration of different life forms

Most of the regenerates were from tree species followed by shrubs and climber species. The proportion of regenerates belonging to tree species was reduced with increase in disturbance (CDI). While the proportion of regenerates belonging to shrubs species increased with increase in disturbance levels (Figure 1). A study reported that, tree species constituted major part of regenerated followed by shrubs and climber species in the evergreen forests of Tamil Nadu. Since trees are the most dominant life forms in the evergreen forests of Western Ghats the regeneration is also higher in this life form. With disturbance the proportion of shrubs and climbers increased since these are life forms that come up in canopy gaps due to disturbance [9]. Previous workers have considered that, openings (gaps) as the start point, the main spring, of the stand dynamic process [10 and 11].

Association of disturbance with the proportion of regenerates belonging to deciduous species in Kodagu and Uttara Kannada

The regenerates belonging to deciduous species varied across the disturbance gradient. The proportion of regenerates belonging to deciduous species was lowest in undisturbed forests followed by highly disturbed and undisturbed forests (Figure 2). It is general trend that with increase in disturbances deciduous species tend to occupy more and more areas and the similar results were reported [7] for undisturbed reserved forests, conserved sacred groves and disturbed sacred groves in the evergreen vegetation types in central Western Ghats.

Association of disturbance with mode of dispersal of regenerates in Kodagu and Uttara Kannada

The regeneration of many species was affected by their mode of dispersal. In all the three disturbed conditions, the proportion of regenerates dispersed by birds was higher and decreased with increased disturbance (Figure 3). Similar results were reported in other studies [9 and 12]. The proportion of regenerates dispersed through birds was also higher compared to mammals and wind dispersed sources. The proportion of regenerates dispersed by the wind increased significantly with increase in disturbance, this could be due the increased wind flow with increase in disturbance.

Distribution of regenerating stems of different regeneration classes across the disturbance gradient

The health of the forest is often indicated by the size class distribution of the community of plants. A reverse 'J' shaped curve for the size class distribution reflects a growing population, with a large proportion of seedlings and saplings [13]. In general, normal regeneration patterns of reverse 'J' shape were observed in undisturbed and moderately disturbed forests (Figure 4). Similar patterns were reported from several forests types such as low land, montane evergreen forests etc [14]. While, in highly disturbed wet evergreen forests in central Western Ghats did not show normal regeneration patterns, that is, proportion of regenerates were lower than the subsequent regeneration class as a consequence of disturbance. The lack of adequate proportion of regenerates in class I (less than 40cms height) could be attributed to higher mortality of seedlings. Similar patterns were seen in the regeneration studies conducted in the sacred forests and reserves forests of Kodagu [7]. A study reported normal patterns of regeneration in different worked and unworked forests of Kodagu [15].

Distribution of regenerating stems belonging to threatened category across the disturbance gradient in Kodagu and Uttara Kannada

The proportion of regenerates belonging to threatened category

showed normal pattern of inverse 'J' shape in undisturbed forests. The moderately disturbed forests of had highest proportion of regenerates in the first regeneration class. Regenerates class II reduced drastically and were completely missing in class III and Class IV. No regenerates belonging to threatened category were found in highly disturbed forests areas (Figure 5). As the proportion of matured stems were very low and with increase in disturbance, the regeneration of threatened species was severely affected, as indicated by the reduction of stems of those threatened species with increasing disturbance. Another study had also reported that, the regeneration of threatened tree species were affected in class I in disturbed areas while normal patterns were reported from undisturbed areas in the sacred forests of Central Western Ghats [16].

Distribution of regenerating stems belonging to endemic category across the disturbance gradient in Kodagu and Uttara Kannada

The endemic species are highly specialized forms requiring specific niches. Due to disturbances and degradations the regeneration of endemic species was less in highly disturbed forests. The normal pattern of regeneration was seen in undisturbed and moderately disturbed forests (Figure 6). Another study has also reported that, percentage of endemic species decreased from closed canopy to disturbed open canopy forests [17].

Regeneration of threatened and endemic tree species across the disturbance gradients

To know the effect of disturbance on regeneration of individual species, five threatened and endemic species were studied and the disturbance, it varied from species to species, as the disturbance is not the sole factor determining the regeneration, which is rather governed by other factors such as flowering, pollination, seed set etc.

All five endemic and threatened species were showed problems with successful development of regenerates (Fig 7- 9). *Myristica dactyloides*, *Symplocos racemosa* were failed to attain adult stage completely with increased disturbances. From the study it was also clearly shown that, *Garcinia gummi-gutta*, *Myristica dactyloides*, *Symplocos racemosa* and *Vateria indica* were highly susceptible to disturbance and they were totally disappeared with higher disturbance.

Table 1. Characterization of disturbance parameters through Cumulative Disturbance Index (CDI) across the different localities

Locations	Disturbance parameters							CDI	CDI Category
	Lopping	Cut	Removal of litter	Soil removal	Grazing	Fire	Weeds		
Marigundi	2	2	1	1	1	0	1	8	MD
Karike	1	1	2	1	1	1	2	9	MD
Makut	1	1	0	1	2	0	1	6	UD
Vatekolli	2	3	3	2	1	2	2	15	HD
Perumbadi	2	2	1	1	0	0	0	6	UD
Patti	0	1	0	0	2	0	2	5	UD
Brianna	1	1	0	0	1	0	1	4	UD
Parakere	2	1	1	0	3	0	3	10	MD
B-shettigere	1	1	1	0	1	0	2	6	UD
Brahmagiri	1	1	1	2	1	1	1	8	MD
Beedalli	0	1	0	0	0	0	1	2	UD

0 – Absent, 1 – Low, 2 – Medium, 3 – High

The total CDI score ranges from minimum 0 to maximum 21, to divide this range in 3 classes, the total value was divided into three ranges that is, 21/ 3= 7 and the different classes are as follows

CDI score	CDI category
0-7	UD (Undisturbed)
7-14	MD (Moderately Disturbed)
14-21	HD (Highly Disturbed)

Table 2. Richness and Diversity of regenerates across the disturbance gradient

Diversity parameters	Undisturbed	Moderately disturbed	Highly disturbed
No. of individuals	483	333	18
Mergalef's diversity index	15.95	13.46	3.37
Menhinick's index	6.85	6.43	2.83
Shannon's diversity	3.58	3.39	1.90
Avalanche index	1.73	1.67	1.19

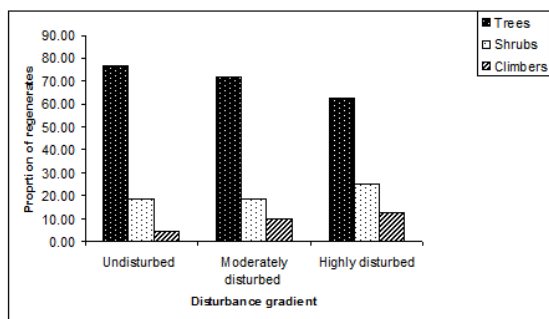


Fig 1. Distribution of different life forms across the disturbance gradients (Chi-Square 3.02, $p < 0.554$)

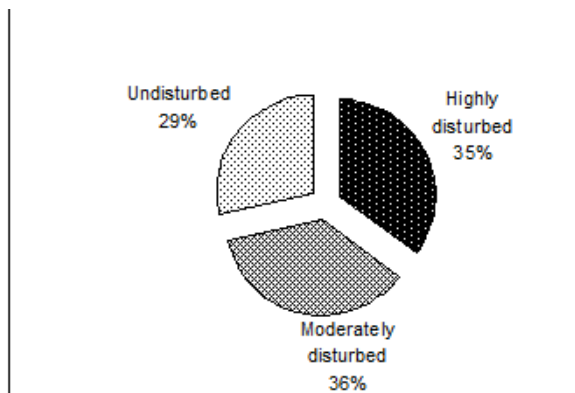


Fig 2. Proportion of deciduous regenerates in evergreen forests

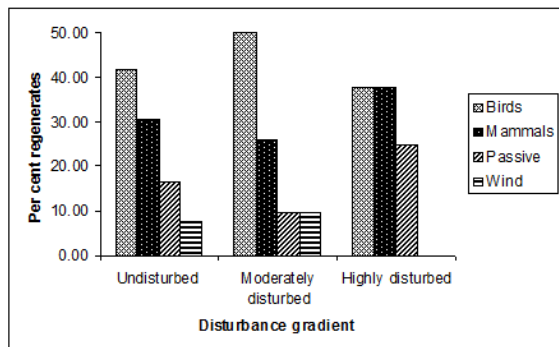


Fig 3. Proportion of regenerates and their mode of dispersal

persal across the disturbance gradient (Chi-Square 19.74, $p < 0.0031$)

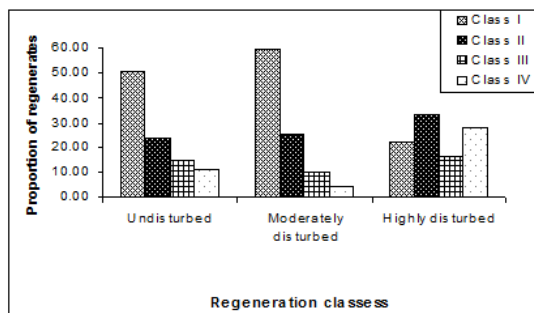


Fig. 4 Proportion of regenerating classes across the disturbance gradient (Chi-Square 40.92, $p < 3.01$)

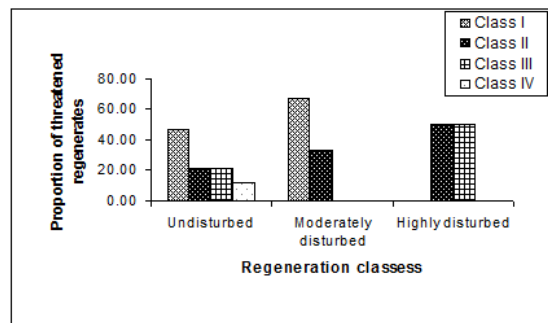


Fig. 5 Proportion of threatened regenerates across the disturbance gradient (Chi-Square 5.49, $p < 0.482$)

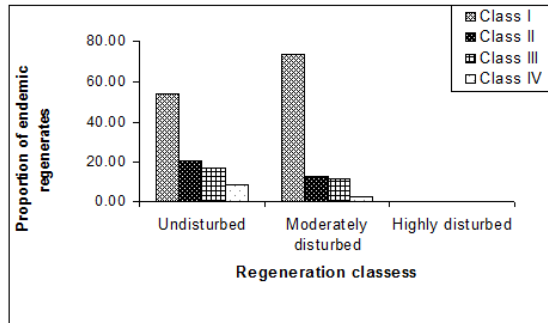
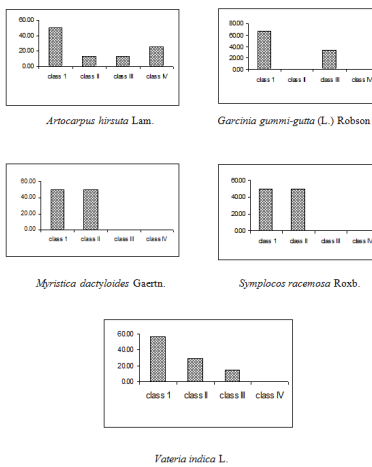
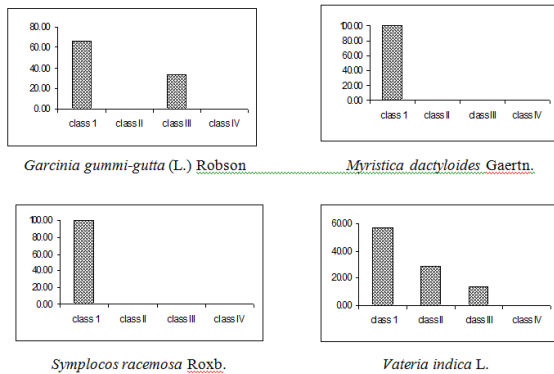
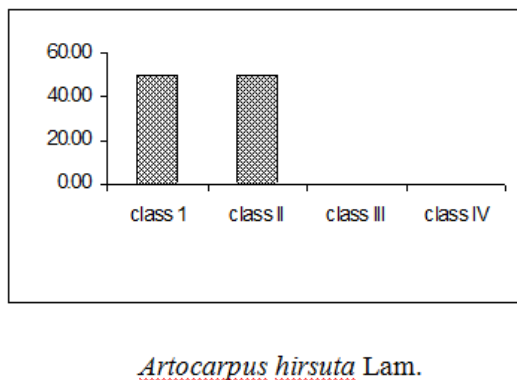


Fig. 6 Proportion of endemic regenerates across the disturbed gradient (Chi-Square 5.55, $p < 0.1354$)



(Proportion of regenerates on Y axis and regeneration classes on X axis)

Fig 7 Regeneration of threatened and endemic tree species in undisturbed forests**Fig 8** Regeneration of threatened and endemic tree species in moderately disturbed forests**Fig 9** Regeneration of threatened and endemic tree species in highly disturbed forests**Conclusion:**

From the present study it was evident that, with increase in the disturbance the regeneration of trees species is being replaced with the regeneration of shrubs and climbers. The regeneration of deciduous elements also increased with increase in disturbance. Higher disturbance has severely affected the regeneration of threatened and endemic tree species, indicating there is an urgent need to plan for the appropriate measure to overcome the problem.

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