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Forest Cuttings and its Impact on Vegetationin the Temperate Forests of Kashmir Himalaya

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ABSTRACT

In the present scenario of global warming and its control, forests have attracted particular interest since they play an essential role in sequestering carbon from the atmosphere. The influence of forest cutting on soil properties were studied in temperate forest of Kashmir Himalaya. On the basis of the intensity of disturbance, two differently disturbed forest sites, High-Disturbed (HD) and Low-Disturbed (LD) sites were selected for sampling. To calculate the beta diversity between disturbed and undisturbed plots of the studied forest site beta part package, R version 3.5.1 was used. The results of the beta diversity showed significant difference in species composition (p = 0.009) between the sites. Highest Fisher's alpha value and Margalefvalue (10.05; 5.61) was observed in LD sites and lowest value (8.38; 4.82) in HD sites, respectively. The results can help to stake holders to develop appropriate decisions for the management of these degraded forests sites for their sustainable development.

1. Introduction

The quantitative analysis of community composition and structure is prerequisite for the precise evaluation of biodiversity (Sahu*et al.,* 2019). Biodiversity provides numerous ecological services that are essential for the survival of humankind, economic well-being and are necessary to generate and support the fundamental ecological functions and stability of ecosystem (Singh, 2002). Maintenance and periodic assessment of forest ecosystems and the biodiversity that it encompasses is crucial for long term forest management and policy-making (Haq et al. 2019; Chakraborty *et al.,* 2018). For assessment of role of forest ecosystem and to achieve sustainable development, it is very important to study the changes in the forest community in relation to increased anthropogenic interferences (Manral *et al.*,2017).

The Himalayan vegetation is subjected to various types of disturbances and most of them are either natural or anthropogenic or both (Malik *et al.,* 2016). Natural disturbances like cloud bursting, land sliding and anthropogenic disturbances like grazing, fodder, the extraction of biomass, fuelwood and collection of litter, construction of roads and dams for hydroelectric projects affect the ecosystem stability. This leads to increased rate of biotic incursions, changes in resource usage, emergence of stresses leading to variations in the climate system, decrease in the number of species and also hinder the succession processes (Kumar and Ram,2005). As much as 76% of all the resource needs are obtained from agro forestry in the Himalaya. The factors leading to increased exploitation of these natural resources includefree as well as easy access and simple usage of such resources (Chettri and Sharma, 2006). All these factors result in habitat degradation which ultimately affects the overall ecological composition of forests, their biodiversity and energetics (Gasparri and Grau,2009).

Understanding diversity patterns, species richness, regeneration status and population structures areofkey

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significance for planning and implementing forest conservation strategies (Malik et al.,2014). In a climax forest ecosystem, tree is fundamental component as it influencesthe resources and habitats for almost all other forest organisms (Sagaret *et al.,*2003; Rawat *et al.,* 2018). In the Western part of Himalayan arc, North-western Himalaya supports the huge vegetation of Himalayan temperate forest type however, the impact of anthropogenic pressure on the population structure and phytosociological attributes are not been given due attention by ecologists till date, are hence poorly understood. In this backdrop, the current research was accomplished to investigate the community composition, regeneration status and population structure of tree species in relation to anthropogenic pressure in the Himalayan temperate forests of Keran valley in the Kashmir Himalaya.

2. Materials And Methods

2.1. Study Area

Keran valley nestled within Kashmir Himalaya, the remotest tehsil of District Kupwara (Fig. 1), is located between 34º 34' 0" - 34º 42' 30" N and 73º 55' 15"- 74º 17' 05" E, and altitude ranging from 1500-4750 masl. Being a side valley, the region is encircled by lofty mountains, deep gorges and grooves, lush green forest vegetation. The region is mostly inhabited by *Pahari* and *Gujjar* tribes. The region is drained by the Kishanganga (Neelum) river. With a total human population of 12026, the region comprises of three *Panchayats* (village administrative units): Keran, Mundiyan and Pathran (Haq *et al.,* 2019).

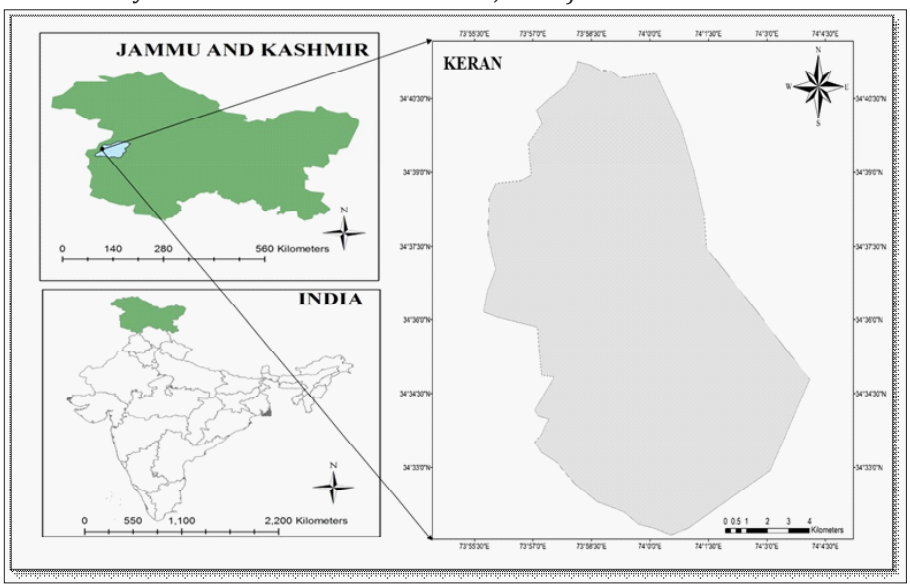

Figure 1. *Map depicting GPS location of present study*

2.2. Sampling Design and Measurements

First of all, field reconnaissance surveys was carried out to get an understanding about the nature of terrain, species composition, accessibility and distribution of different forest types present in the study area. The working plan of Kehmil Forest Division was consulted for authenticating of geographical location, administrative jurisdiction and forest vegetation types. For present investigation, the comparable forest sites basedon the degree of disturbance were selected for sampling: hereafter designated as High-Disturbed (HD) sites and Low-Disturbed (LD) (Table 2). The relative scale of disturbance types in these sampled sites was characterisedas per proposed by Seipel *et al.* (2012). The three-point scale (0 = none-low, 1 = moderate, 2 = high) was used to record disturbance levels based upon a visual assessment in the vicinity of each sampling site. During the present study, disturbance drivers such as stem cutting (CT), tree lopping (LP), live stockgrazing (GZ), alien invasion (AI), degradation (DG), road connectivity (RC), distance from human settlements (DS), collection of non-timber forest products (CN) and fire (FR) were taking into consideration to characterize disturbanceintensity of the selected sampling sites (Table 1).

Table 1. *Details of the forest sampling sites in the Keranvalley, Kashmir Himalaya*

Parameter	LD site	HD site
Geo-coordinates	34º 39' 06.2" 73º 57' 18.6"	34º 38' 52" 73º 57' 59"
Altitudinal range	1550-1650 masl	1530-1630 masl
Slope (°)	34 ± 15.24	38 ± 8.04
Crown density (%)	53 ± 8.38	48 ± 5.06
Stem/stump ratio	4.9	1.7

The quadrant method of vegetation sampling as per (Haq*et al.,* 2019) was used to recordfloristic diversitydata of the study area.In each of the selected forest types, four sample plots, each of 31.6 m x 31.6 m (≅ 0.1 ha) size in all the four directions i.e. NE, NW, SW and SE, respectively were laid for trees sampling. In each sample plot, density of live stem plus dead (loss by stump cuttings) was recorded. Within each (0.1 ha) plot, 4 sub-plot of sized 5 m×5 m were used for recording shrubs, seedling and saplings. In total, 32 forest stands (total of 8 plots per forest type) were sampled in the present study. In order to minimize any sampling bias, as far as possible, it was ensured to accommodate the differences in vegetation growth caused by variation in slope and aspect. GPS device named Garmin, GPS map76cs was used for assessment of altitude as well as measurement of forest sites. The slope angle was measured using a clinometer. Importance Value Index (IVI) was used for measurement of plant dominance. The IVI was determined as the sum of relative frequencies, densities and dominances of plant species (Curtis and McIntosh,1951; Naidu and Kumar, 2016). The totalnumber of species present in a given forest were counted as species richness. The main diversity indexes Shannon–Wiener (1948), Simpson (1949), Margalef richness index, Evenness Index (Pielou, 1975),Dominance index was calculated.

2.2.1. Statistical Analysis

Beta diversity estimation

We calculated beta diversity between disturbed and undisturbed plots of the studied forest site using *betapart* package (Baselga and Orme, 2012) in R version 3.5.1 (R Core Team 2019). Further, boxplot were created to observe the distance of values of beta diversity of each site in relation to their centroids (basically, this indicates homogeneity in how communities of a given treatment differ from each other). Then, we performed an ANOVA to test if treatments (here disturbed and undisturbed plots) are significantly different. The diversity indices Shannon–Wiener, Margalef richness, Equitability, Dominance were calculated using PAST software ver.3.14.

3. Results

3.1. Forest Diversity and Phytosociological Attributes

The forests of Keran Valley are mixed forest type comprising of both conifers and broad leaved tree species. A total of 37 plant species belonging to 35 genera and 23families were reported from the study area (Table 2). Maximum number of species were represented by herbaceous life form (76%), followed by trees (13%) and shrubs (11%). Out of total 37 species, 31 plant species associated with 29 genera and 20 families were documented at LD site and 26 plant species belonging to 25 genera and 20 families were listed at HD site.

Shannon diversity indices varied from maximum of 2.99 at LD sites to a minimum of 2.46 at HD sites. Simpson's diversity indices showed striking similarity across all study sites, ranging from 0.92 at LD sites to 0.93at HD sites. Evenness ranges between a maximum of 0.74 at HD sites, to a minimum of 0.64 at LD sites. The highest values of Fisher's alpha value and Margalef value (10.05; 5.61) was observed at LD sites and lowest value (8.38; 4.82) in HD sites. Overall, average tree density of 201N ha^{-1} was recorded. Maximum of 222 ± 60 N ha^{-1}at LD sites and minimum was 180 ± 67 Nha^{-1} at HD sites respectively.

The results of the beta diversity analysis between the disturbed and undisturbed plots are represented in the figure 2 a-b. A significant difference in species composition was observed (*p = 0.009*; Table2) between these plots.

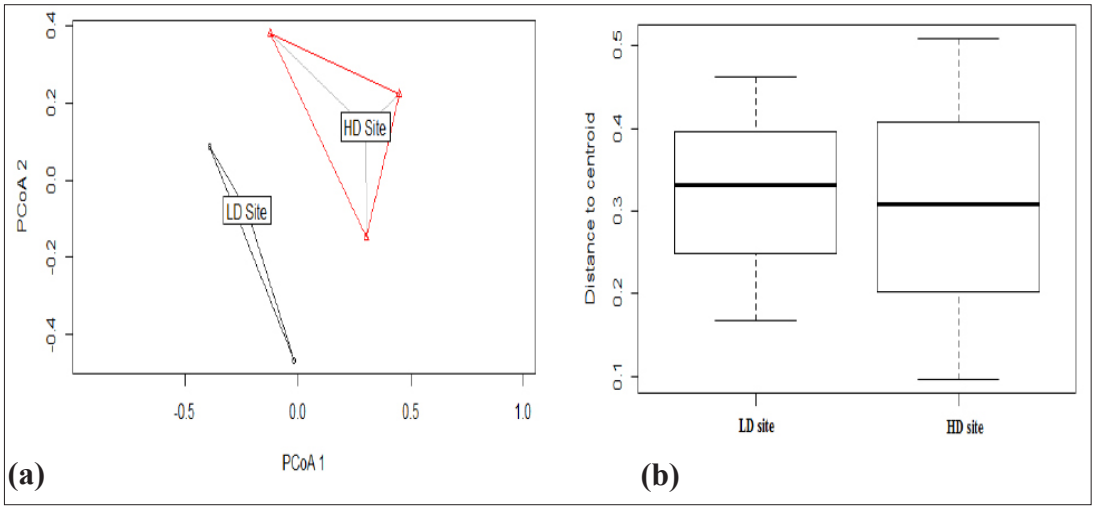

Figure. 1 *(a) Beta diversity between disturbed and undisturbed plots of forest site based on vegetation composition, (b) boxplots showing the distance of values of beta diversity of each plot in relation to their centroids {results are shown as mean ± standard error of mean (SEM)}.*

4. Discussion

The detailed structure and function of ecosystem can be well understood by thorough study of the floristic composition of forest(Singh *et al.,*2016). In addition, the knowledge about the regeneration capacity of the species of trees in a forest is also important so that the conservation measures can be taken accordingly. In the current investigation, an attempt was made to study the community architecture, population structure and tree regeneration status with regard to anthropogenic disruption in two forests of Keran Valley of Kashmir Himalaya, India. Diversity, which is contemplated as a function of the relative distribution of individuals among species, is regulated by long-term factors such as community stability and evolutionary time (Verma*et al.,* 2004; Singh *et al.,* 2016). The floristic analysis relieved that species richness in the sampled forest sites are similar with of several phytosociological related investigations in Himalayas (Kumar and Bhatt, 2006; Shaheen*et al.,* 2011; Dar and Sundarapandian, 2016).The values of the Shannon-Wiener diversity index ($\bar{H}$) reported in the current study was 2.48 (LD site) and 1.89 (HD site). These values are comparable with the Ghildiyal et al. 1998 (1.86-2.73) from Garhwal Himalaya, Uniyal*et al.,* 2010 (0.70-3.08) from Garhwal Himalaya, Pant and Sammant, 2012 (0.74-2.66) from North-Western Himalaya, Shaheen*et al.,* 2012 (0.75-2.27) Pakistan Himalaya, Malik and Bhatt 2015 (2.30) from Western Himalaya, Singh et al. 2016 (1.49-1.86) from Garhwal Himalaya and Rawat et al. 2018 (1.58-2.78) from Eastern Himalaya.

The stem density recorded in the present study (222 trees ha^{-1} at LD site and 181 trees ha^{-1} at HD site) is within the range reported from different areas of Himalaya. For example, 35-930 $treesha^{-1}$ by Singh et al. (2016) reported fromGarhwal Himalaya. Malik and Bhatt (2015) while carrying out the phytosociological analysis ofdifferent forests of Kedarnath Wildlife Sanctuary reported tree density of 235-505 trees ha^{-1}; 90-302 trees ha^{-1} by (Shaheen*et al.,* 2012)from Pakistan, Himalayas. The total basal area (m^2/ha) reported was 28.4 ±8.5 (LD site) and 35.76 ± 11.53(HD site).These values are more or less comparable with those reported by Sahu et al. (2019) (30.64 m^2/ha)from Saptasajya hill range, India;Dar and Sundarapandian, (2016) (19.4-51.9 m^2/ha) Western Himalaya,India;Singh and Gupta, (2009) reported (18.49-52.54m^2/ha) from Himachal Pradesh, India;A comparatively higher value (42.2-105.2 m^2/ha)by Shaheen*et al.* (2012) from Pakistan, Himalayas; (69.31 m^2/ha) in the subtropical forests lesser Himalayas (Shaheen*et al.* 2011); (33.36-78.98 m^2/ha) by Dar and Sahu (2018)fromNorthwestern Himalaya; (94.18 m^2/ha) by Mane *et al.* (2019) from Baratang Reserve Forest, India.

Conflict of Interest

The authors declared no conflict of interest

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