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RESEARCH ARTICLE

Status of *Debregeasia salicifolia* (Roxb. ex D. Don) Rendle in the degraded land of Kumaun Himalaya, Uttarakhand

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Abstract

Forest structure and composition is the fundamental issue in ecology which are strongly correlated with environmental factors, such as climate and topography, microclimate aspects and altitude. Structural and functional analysis of plants provides valuable information for understanding relationship between plant form, vegetation structure and environment. The present investigation was aimed to carryout population structure and regeneration pattern of *Debregeasia salicifolia* (Roxb. ex D. Don) Rendle stand. Saplings has maximum density 17840 (ind/ha) followed by trees 980 (ind/ha). The maximum relative density (57.690) was recorded for saplings followed by trees (37.83) and seedlings (4.47). The maximum diversity index (H') was 0.179 for saplings and minimum for (0.017) trees. The maximum concentration of dominance was recorded for saplings (0.360) and minimum was recorded for seedling (0.004). The study area severely affected by anthropogenic disturbances as the conversion of saplings into trees was very poor as well as the seedling survival was at its lowest stage.

Introduction

The genus *Debregeasia* belongs to the family Urticaceae commonly known as Tusyar or Tushiyari. Species comes under the huge shrubs grows to a height of 5 meters in the forest habitat in 1500 to 2400m. There are sixteen species of *Debregea sia*occurring in different parts of the world whereas *Debregeasia salicifolia* occurs in the West Asia and Western Himalayan (Negi *et at*., 2002). Patterns of population dynamics of seedlings, saplings and trees of a plant species can exhibit the regeneration profile. Regeneration is a key process for the existence of species in the community and is also a critical part of forest management, because it can help forests to maintain the desired species composition. *Debregeasia* species naturally grown in wide

habitats and can be propagated artificially for its various uses. The leaf of the species is used for fodder, litter for farm uses, wood for fuel and bark contain fiber that is making ropes. *Debregeasia* sp. bark paste is applied externally on forehead to relieve from headache (Negi *et al*., 2002). Apart from above uses; *Debregeasia* species are suitable for soil and water conservation particularly in landslides, landslips and other freshly degraded and damaged sites.

The regeneration status of trees can be predicted by the age structure of the population (Saxena and Singh, 1984; Khan *et al.,* 1987; Bargali *et al.,* 1989). The presence of sufficient numbers of seedlings, saplings, and young trees in a given population indicates good regeneration (Saxena and Singh, 1984). Regeneration of tree species is greatly affected by interactions of biotic and abiotic factors of the environment (Aksamit and Irving, 1984). The sustained regeneration and growth of all species in the presence of older plants are required for better growth of any plant community (Taylor and Zisheng, 1988). Various changes in the Himalayan Forests are appearing in their structure, density, composition and regeneration due to biotic pressure on them namely, uncontrolled lopping and felling of trees for fuel wood, fodder and grazing (Kumar *et al.,* 2006; Bargali *et al.,* 2013; Bargali *et al.,* 2014). However increasing anthropogenic pressure within Himalayan zone from some decades has caused extensive deforestation which in turn has increased massive soil erosion in the hills and floods in the plains and consequently the silting of rivers. These forests have been under a tremendous biotic stress as they provide fuel (both charcoal and firewood), food and leaf fodder (Zobel *et al*., 1995; Pande *et al.,* 2014).

The presence of older tree is better for establishing young seedling as they provide shade and microclimate (Taylor and Zisheng, 1988). The seedling, sapling and young trees make greater contribution to the total population in successful regeneration (Khan *et al*., 1987). The future communication structure and regeneration potential of the species could be predicted from relative proportion of seedlings and saplings in various species in the forest. Natural regeneration and estimation of primary forest species are the crucial for most of species. The present study was therefore, carried out in old degraded site of Nainital to assess the population structure and regeneration status of *Debregeasia salicifolia.*

Material and methods

Study site

The Himalayan chain of mountains, extending from west to east for about 2500 km and in width varying between 150 to 450 km, is known to be the youngest, largest and highest chain of mountain in the world. Kumaun Himalaya is located between latitude 28°43'45''- 30°20'12''N and longitude 78° 44' 30'' – 80°18'45''E in the central Himalayan belt which shares the characters of both eastern and western Himalaya (Anonymous, 1977). The present study area located at Thandi road in Nainital located between 29º21'- 29º24' N latitude and 79º25' - 79º29' E longitudes and have faced the landslide bout 13 years back (Shahi *et al*., 2014). The large study area was divided into 5 sub-sites. The study area was mostly dominated by *Debregeasia salicifolia* having significant and useful aspects in the daily life of adjacent hill community. The altitude of this whole study area ranged from 1938m to 2200 m asl (Fig. 1) of Kumaun region of Uttarakhand.

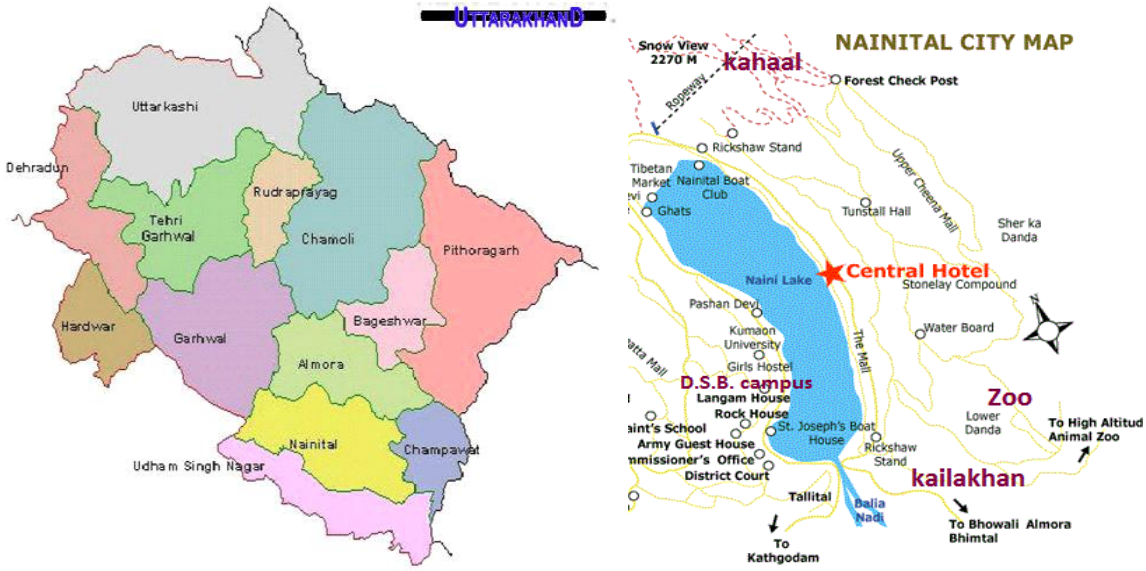

Figure 1: Location map of study area

Climate

The climate of Nainital is characterized by long-cold often snowy winter and short summer. It is temperate and monsoon type (Singh and Singh, 1987). The monsoon usually strikes in this area in mid June to middle or end of September. Generally high temperature remains between March and July where it reaches maximum and decreases gradually after July. The maximum rainfall occurs during July and August. The recorded rainfall in the year 2011 was 2619.7mm. During study period the humidity ranged from 38.3 % to 90.2 % while temperature ranged from 3.9^{0}C to

25.5^{0}C (Fig. 2).

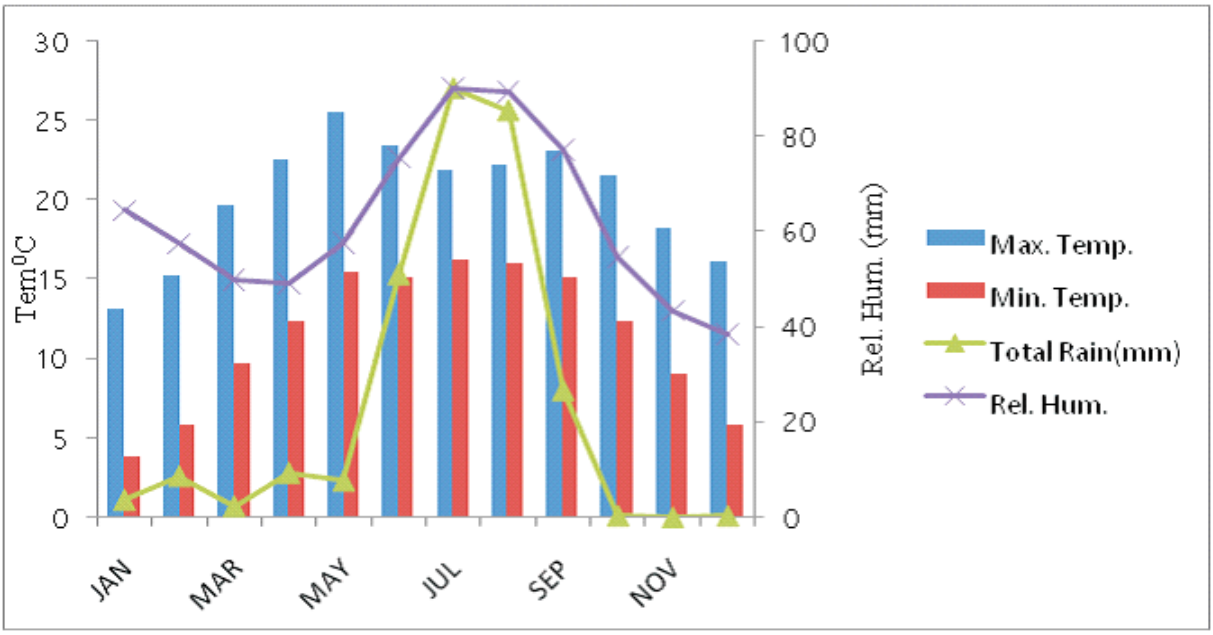

Figure 2: Monthly meteorological observations during the study period (from January to December, 2011)

Methodology

The phytosociological analysis of tree, sapling and seedling layers was carried out by randomly laying down 10 quadrates of 10×10m size in each sub-site. The size and number of samples were determined according to the method of Saxena and Singh (1982). For regeneration, each quadrate of 10×10m size individuals having >31 cm CBH (Circumference at breast height i.e. 1.37 m above the ground) was calculated as trees, individual having < 10 cm CBH were consider as seedling and individual having CBH from 10-30 cm CBH were considered as sapling (Curtis and McIntosh, 1950).The vegetation data were quantitively analyzed for abundance, density and frequency (Curtis *et al*., 1959). The index of general diversity was computed by using Shannon- Wiener index (H'), (Shannon- Wiener, 1963). The concentration of dominance (Cd) was measured by Simpson's index (Simpson, 1949). The density of seedlings and saplings is considered as an indicator of the regeneration potential. The criteria for regeneration status in the present study were based on the number of seedlings and samplings of individual species. The regeneration status of the sampled species was based on phytosociological data (Uma Sankar, 2001) in the following categories:

- Good regeneration, number of seedlings > saplings > adults.
- Fair regeneration, number of seedlings > or ≤ saplings ≤ adults.
- Poor regeneration, if the species survive only at sapling stage, there are no seedlings

(Number of saplings may be more, less or equal that of adults).

- No regeneration, individuals of species are present only in adult form.
- New regeneration, individuals of species have no adults but they show only seedling or saplings.

RESULTS

The study area was nearly pure *Debregeasia* stand as it was dominated by *Debregeasia salicifolia.* Some shrub species as *Berberis asiatica, Rubus ellipticus*and *Deutzia* were also present in very less number at study area. The density, frequency and total basal area was calculated (Table 1) for the species. The maximum density (1740 ind/ha) was observed for saplings while the total basal area (11.681m^2/ha) was highest for trees. The saplings and trees were present at all sub-sites but seedlings were totally absent at sub-site 4 & 5 (Fig. 3). The maximum diversity index (H') was (0.179) for saplings and minimum (0.017) for trees. The maximum concentration of dominance (Cd) was (0.360) observed for saplings and minimum (0.004) was recorded for seedling (Fig.4).The overall relative density among all sub-sites was maximum (57.690) for saplings followed by trees (37.83) and seedlings (4.47) (Fig. 5).

Table 1: The analysis of *Debregeasia salicifolia* for different parameters in study area of Nainital

Category	Density (ind/ha)	Frequency (%)	MBA (m^2/ha)
Seedling	180	100	0.038
Sapling	1740	100	7.314
Trees	980	100	11.681

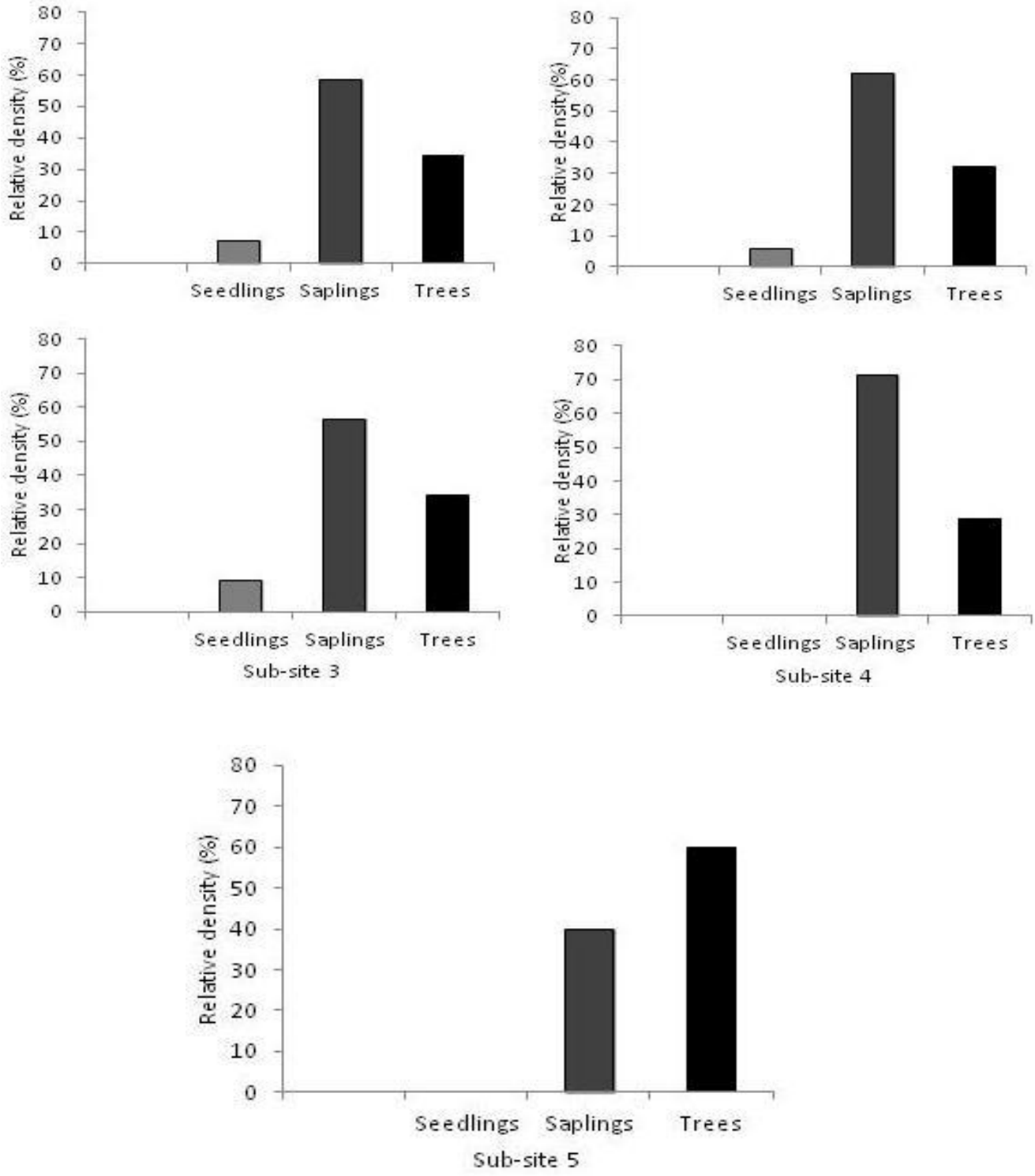

Figure 3: Population structure of *Debregeasia salicifolia* at different sub-sites

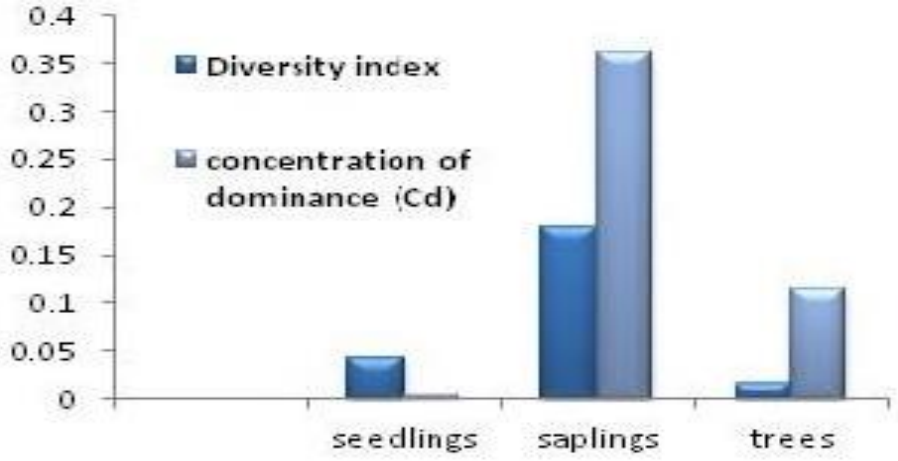

Figure 4: Diversity index (H') and concentration of dominance (Cd) of *Debregeasia salicifolia* at different category in study area

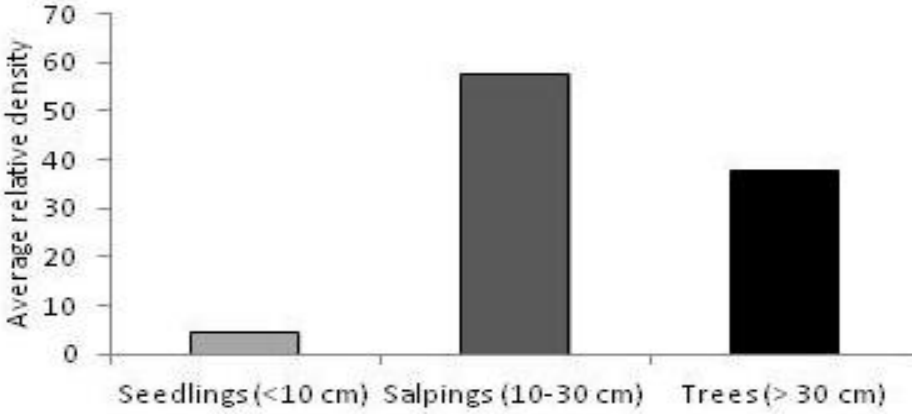

Figure 5: The average relative density among seedlings, saplings and trees of *Debregeasia salicifolia* of the study area

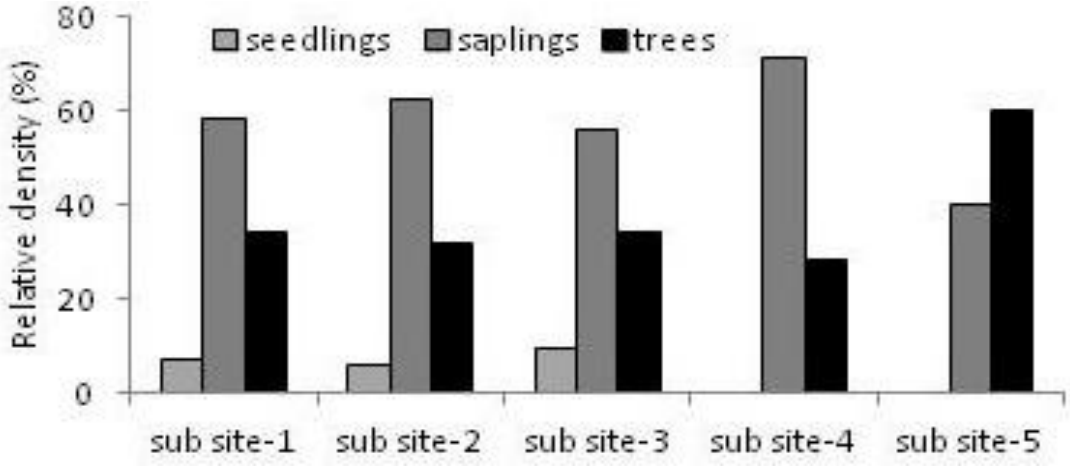

Figure 6: The comparison of relative density of *Debregeasia salicifolia* at different sub-sites

DISCUSSION & CONCULATION

The Himalaya is a very diverse ecosystem sustaining a wide range of vegetation types. The biodiversity of region is severely threatened by natural and anthropogenic disturbances. The floristic analysis of Kumaun Himalaya was extensively studied by a number of workers (Saxena and Singh, 1984; Tewari and Singh, 1985; Tripathi *et al*., 1991; Singh and Singh, 1987; Sharma *et al*., 2014).The structure and function of forest ecosystem is determined by the plant component in the system (Richards, 1996). The seedlings have lowest contribution in overall relative density and all other observed parameters. The regeneration status of species is affected by anthropogenic factor (Barik *et al*., 1996). The comparison of relative densities of all sites showed that the highest percentage of seedlings were observed at sub-site 3, highest no. of saplings were present at sub-site 4 and highest percentage of trees was present at sub-site 5 (Fig. 6). In all sub-sites the saplings has significant number than trees and seedlings. But the conversion of saplings into trees was poor as well as the production of seedlings and their survival rate was very drastically reduced. The population structure indicated poor regeneration of *Debregeasia salicifolia* in the studied sites. The anthropogenic pressure and disturbance gradients increased up to that level where the seedlings were totally absent in sub site 4 & 5.The anthropogenic disturbances of these sites include deforestation, grazing, lopping of tree branches for fodder and fuel wood, removal of leaf and wood litter from the forest floor and frequent fire. The problem with the chronic form of disturbance is that plants or ecosystem often do not get time to recover adequately because the human onslaught never stops (Singh, 1998; Arora *et al*., 2011; Jhariya and Oraon, 2012). The *Debregeasia* used for many purposes like fodder; fuel etc in irregular manner by hill communities and that's the main reason for poor regeneration of this pure *Debregeasia salicifolia* stand. The anthropogenic disturbances occur in the form of high animal grazing, lopping of trees and shrubs for fodder and fuel and litter removal among all the sites (Shahi *et al*., 2014). Forest composition, community structure and diversity patterns are important ecological attributes significantly correlated with prevailing environmental as well as anthropogenic variables (Timilsina *et al*., 2007; Gairola *et al*., 2008; Ahmed, 2012; Kittur *et al*., 2014). The study revealed that this forest has been played an important role for fulfilling the basis livelihood needs for local community in the form of fuel wood, fodder, small timber etc. Due to inappropriate consumption of its floral wealth in an irregular manner the pure *Debregeasia salicifolia* stand has been threatened. Therefore, early conservation strategies could

be helpful to sustain this pure stand for future generations.

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