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Regeneration status of major forest communities of dry temperate forests of district Kinnaur of Himachal Pradesh.

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ABSTRACT
The present study was carried out in dry temperate forests of Kinnaur district of Himachal Pradesh. In six major forest communities types maximum number of recruits were observed for dry deodar forest (25278 N ha^{-1}) and minimum in dry broad-leaved and coniferous forests [1574N ha^{-1} (Quercus ilex), 1759N ha^{-1} (Pinus gerardiana)]. Whereas, un-established regeneration was maximum in dry blue pine forest (2778 N ha^{-1}) and minimum in dry broad-leaved and coniferous forests [1018 N ha^{-1} (Quercus ilex), 370 N ha^{-1} (Pinus gerardiana)]. The Regeneration success was recorded maximum in dry deodar forest (58.33 %) however, it was minimum for neoza pine forest i.e. 27.78 % (Pinus gerardiana). Percent regeneration success was fair in dry deodar forest while, poor values in neoza pine forests. It may be due to favourable conditions in dry deodar forests for regeneration and growth of seedlings resulting in high number of recruits and established regeneration in that forest type as compared to other forest types in contrary, poor per cent regeneration success of neoza pine forest might be due to harsh climatic, edaphic and anthropogenic conditions of the region.
KEYWORDS: *Natural regeneration; Recruits; Un-established regeneration; Established regeneration; Regeneration success; Himachal Pradesh*.

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INTRODUCTION

Himalayan forest ecosystem has a major contribution to the mega-biodiversity of India. Therefore, the conservation and scientific management of this biodiversity for socioeconomic development, betterment of soil, live-stock and human assumes a great significance. Various aspect of biodiversity of these forests has been studied by Dhar et al. (1), Silori (2), Kumar (3) and Khera et al. (4). In north- western Himalayan States of Himachal Pradesh, Jammu and Kashmir and Uttarkhand occupies about 31% of the total coniferous area, accounting about 49% of the total growing stock in these states. Spruce and silver fir species are usually found associated with deodar, blue pine, chir pine and also with broadleaved species like oaks, walnut, burash, etc. Natural regeneration of these species is however, generally deficient and in many areas conspicuous by their absence. Besides a number of factors considered responsible for the absence of natural regeneration of these species; lack of adequate light on the forest floor in the forest managed under selection system, thick layer of humus accumulation of debris, dense weed growth and continuous grazing (Dhillon, 1961), poor seed production, infrequent seed years and other biotic factors (5) are the major factors. More litter fall and low decomposition rates (6) have been identified as the hindrances thereby affecting the natural regeneration of these species to a considerable extent. Excessive deposits of needles are inimical to the regeneration of all coniferous trees; complete removal of the sour un-decayed humus would enable seedlings to establish in the forests. Soils have many ecological roles, including being a medium for plants to grow in, recycling nutrients and waste, providing a habitat for soil organisms, filtering rain water, etc. Forest soils influence the composition of the forest stand and ground cover, rate of tree growth, vigour of natural reproduction and other silvicultural important factors (7).

MATERIAL AND METHODS

The present study was carried out in dry temperate forests of Kinnaur district of Himachal Pradesh situated at 77°45'00'' and 79°00'35'' E longitude and between 31°05'50'' and 32°05'15'' N latitude. Different forest types identified as per classification of Champion and Seth (8). The area fall under Kinnaur Forest Division of Rampur Circle of Himachal Pradesh. To study the regeneration status of dominant forest species, 9 sub-quadrates of 2 m × 2 m within each quadrate of size 20 m× 20 m were laid out. The regeneration studies were also carried out on recruits, un-established and established in major forest communities of dry temperate forest recruits, un-established and established, and per cent regeneration was calculated following Chacko (9).

RESULTS AND DISCUSSION

Recruits, Un-established, Established and Height of un-established regeneration

In six major forest types maximum number of recruits were observed for dry deodar forest (25278 N ha^{-1}) and minimum in dry broad-leaved and coniferous forests [1574N ha^{-1} (*Quercus ilex*), 1759N ha^{-1} (*Pinus gerardiana*). Whereas, un- established regeneration was maximum in dry blue pine forest (2778 N ha^{-1}) and minimum in dry broad-leaved and coniferous forests [1018 N ha^{-1} (*Quercus ilex*), 370 N ha^{-1} (*Pinus gerardiana*). However, established regeneration were maximum in dry deodar forest (833N ha^{-1}) and minimum in sub alpine fir forest (277 N ha^{-1} *Abies pindrow*), (0 N ha^{-1} *Abies spectabilis*). The height of un-established regeneration was recorded to be maximum in dry deodar forest (386.67 cm) whereas, minimum height was observed in neoza pine forest (116.67 cm) (Table 1). High number of recruits were recorded in deodar forest which may be due to adequate number of seed bearers and shade site condition as also reported by Kumar et al. (10) in Chail wildlife sanctuary Minimum number of recruits in dry broad-leaved and coniferous forests may be attributed to lack of seeds of oak due to frequent lopping of trees for fodder, fuel and grazing, which was also reported by Ammer (11). In addition, collection of cone of *Pinus gerardiana* by the local people for extracting seeds/nuts for cultural and commercial purposes (12,13) has also caused lack of seeds for regeneration in this forest types. The established regeneration was maximum in dry deodar forest whereas, un-established regeneration was maximum in dry blue pine forest. It seems that there had been less proportionate conversion of un-established to established regeneration, for blue pine forest which may be attributed to thick litter layer which acts as a physical barrier between roots and soil (14,15,16,17,18) and higher biotic interference (grazing and trampling by animals) at that site. The better regeneration of deodar forest might be attributed to less thickness of organic matter, higher available nitrogen, available potassium and soil pH.

Table 1. Regeneration status of different major forest type in dry temperate and alpine forest

Sr. No	Different forest type	Recruits ha^{-1}	Un-established ha^{-1}	Established ha^{-1}	height of un-established regeneration (cm)
1.	Dry broad-leaved and coniferous forests	1574*,1759***	1018 *, 370***	370 *,277 ***	174 .44*24.44 ***
2.	Neoza pine forest	11111***	1667***	278***	116.67***
3.	Dry deodar forest	25278**	2500**	833**	386.67**
4.	Dry blue pine forest	17222****	2778****	556****	380.00****
5.	Sub alpine birch forest	7222*******	1111*******	556*******	166.67*******
6.	Sub alpine fir forest	9722*****, 5000******	1388*****, 555******	277 *****, 0 ******	113.33*****, 116.67 ******

Quercus ilex; **Cedrus deodara; ***Pinus gerardiana; ** Pinus wallichiana*
******Abies pindrow; ******Abies spectabilis; ******* Betula utilis forest*

Table 2. Establishment and regeneration success rate of different major forest type in dry temperate and alpine forest

Sr. No	Different forest type	Weighted average height (cm)	Establishment index	Stocking index	Establishment Stocking (%)	Reg. Success (%)
1	Dry broad-leaved and coniferous forests	168.70*,77.78***	0.84*,0.39***	0.25*,0.15***	22.48*,11.02***	25*,14.81***
2	Neoza pine forest	183.33***	0.92***	0.28***	15.97***	27.78***
3	Dry deodar forest	388.33**	1.94**	0.58**	49.65**	58.33**
4	Dry blue pine forest	400.00****	2.00****	0.50****	38.06****	50.00****
5	Sub alpine birch forest	300.00*******	1.50*******	0.33*******	29.17*******	33.33*******
6	Sub alpine fir forest	163.33*****, 90.00******	0.82***** ,0.45******	0.25*****, 0.11******	35.28*****, 4.86******	25*****, 11.11******

Weighted average height, Establishment index. Stocking index, Establishment Stocking % and Regeneration success (%)

Among the six different forest types maximum weighted average height was recorded in dry blue pine forest [400 cm (*Pinus wallichiana*)] and minimum in neoza pine forest [183.33 cm (*Pinus gerardiana*)]. Establishment index is however found to be maximum in dry blue pine forest [2.00 (*Pinus wallichiana*)] and minimum was observed in neoza pine forest [0.92 (*Pinus gerardiana*). It was evident that Stocking index with maximum values of 0.58 was recorded in both dry deodar forest, while it was minimum in neoza pine forest 0.28 (*Pinus gerardiana*). The data revealed that the maximum values of establishment Stocking percent was found maximum in dry deodara forest 49.65 per cent and minimum was recorded in neoza pine forest 15.97 per cent. The Regeneration success was recorded maximum in dry deodar forest (58.33 %) whereas; it was minimum for neoza pine forest i.e. 27.78 % (*Pinus gerardiana*). The data on regeneration establishment stocking and percent regeneration success (Table 2) revealed that both establishment stocking and percent regeneration success was maximum in dry deodar forest while, minimum values in neoza pine forests. It may be due to favorable conditions in dry deodar forest for regeneration and growth of seedlings resulting in high number of recruits and established regeneration in that forest type as compared to other forest types.

CONCLUSION

Regeneration studies of major forest types reveals that established regeneration was found fair in dry deodar forest (833N ha^{-1}) and poor in sub alpine fir forest (277 N ha^{-1} *Abies pindrow*), (0 N ha^{-1} *Abies spectabilis*). *Abies spectabilis* seems to be under threat as establishment regeneration of these species was absent. Poor performance of establishment regeneration in fir forest which may be attributed to thick litter layer which acts as a physical barrier between roots and soil and long good seed year. Regeneration success per cent under different forest types was found pitiable in neoza pine forest i.e. 27.78 % (*Pinus gerardiana*). Wheras, it was fine in dry deodar forest. It may be due to favourable conditions in dry deodar forests for regeneration and growth of seedlings resulting in high number of recruits and established regeneration in that forest type as compared to other forest types.

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