Original Research Article

REGENERATION STATUS OF DIFFERENT CONIFERS IN GULMARG FOREST RANGE OF KASHMIR HIMALAYAS.

ABSTRACT

The present study was concentrated in the four forest blocks, namely Khaipora, Tangmarg, Ferozpora and Baderkut of Gulmarg Forest Range in Kashmir Himalayas. Natural regeneration and edaphic factors affecting regeneration status of different conifers was studied. Quadrats of 2x2m in the main plot of size 50x20m were laid down to study the regeneration at four blocks of Gulmarg Forest Range. The maximum numbers of recruits (current year seedlings, less than height of 8 cm), unestablished (height more than 8cm to 200cm) and established (height more than 200cm) plants were found for *Abies pindrow* at all the sites with the exception at Ferozpora where unestablished plants of *Pinus wallichiana* were found highest. Highest establishment stocking per cent and regeneration success was found for *Abies pindrow* at Khaipora, Ferozpora and Baderkut. Overall regeneration success was found to be highest at Baderkut followed by Khaipora while as the lowest regeneration success was found at Ferozpora respectively. Simple correlation study reveal that the regeneration success has a significant positive relationship with Light Intensity, pH, Electric conductivity, organic

carbon, available nitrogen and available potassium while as litter layer and available phosphorous had a significant negative correlation with regeneration success.

Key words: Natural regeneration, Regeneration success, edaphic factors, Conifers.

Introduction:

The Himalayan Forest ecosystem plays a substantial role in providing many ecological services to the human population and their livestock; however due to inadequate and unreliable information, management of these forest types have not been addressed suitably. Most watersheds in the Himalayan region are experiencing a decline in different forest covers and agricultural land use type has happened to be the main constituent of the current landscape (Sundriyal*et al.*, 1994). In India, conifers are one of the most valuable natural resources which contribute significantly to its socio-economic development by providing goods and services to the people and industries. They play a major role in enhancing the quality of environment by influencing the basic life support system and generate considerable revenue. In Western Himalayas, the Himalayan moist temperate forest, extending from 1500-3000 m amsl is of immense significance from the environmental conservation and sustainable development (Sharma and Baduni, 2000). Although qualitative descriptions of the forest vegetation of the Himalayas are available (Champion and Seth, 1968), scattered attempts on quantitative

examinations have also been made (Saxena and Singh, 1982; 1984; Ali *et al.*, 2009). Regeneration is a key process for the survival of species in a community under diverse environmental conditions. Assessment of regeneration status of plant communities has a paramount importance for sustainable conservation and management. Natural regeneration is essential as it addresses mainstream biodiversity concerns. Therefore, it is necessary to pay attention to the quantitative and qualitative factors and environmental conditions to study the regeneration status in a forest (Karami *et al.*, 2017).

Inadequate regeneration is the main problem of forests in mountain regions (Krauchii*et al.*, 2000). Sustainable conservation of forests involves proper planning and management of seedlings, saplings and young trees that ensure maintenance of forest community structure and ecological stability (Moravie*et al.*, 1997). Successful management of forest covers need reliable research data on aspects such as structural attributes and demographic profile of tree species. Therefore, it is important to study the regeneration potentials of different natural forest trees in Kashmir Himalaya to determine the probable trends of vegetation in the future.

Materials and Method

Study area: The study area is in Gulmarg forest range of Jammu and Kashmir Himalayas. Gulmarg forest range is divided into seven blocks out of which we conducted study in four blocks*viz*; Khaipora, Ferozpora, Tangmarg and Baderkut in during 2019-2020.The Gulmarg Forest range is situated between 34 °3´ 31.2 ″

N to 74° 23´ 1.0″ E. The total area of Gulmarg forest range is 15933.78 ha.The procedure of Stratified random Sampling was followed.

Table 1: Details of the study area

Block	Block Name	Elevation (m amsl)	Longitude	Latitude	Aspect	Slope
1	Khaipora	2345	34°03´15.9″N	74°24´40.0″E	NW	35°
2	Tangmarg	2265	34°03´40.93″N	74°25´15.58″E	NE	35°
3	Ferozpora	2365	34°2´55.59″N	74°28´50.98″E	SW	45°
4	Baderkut	2221	34°02´25.64″N	74°27´04.29″E	NE	45°

Regeneration assessment:

The regeneration status of different conifers was recorded on the basis of the number of individuals occurring at seedling, sapling and pole stage in each quadrate. The height of unestablished, established plants and recruits were measured for the assessment of regeneration (champion, 1935).The data collected was analysed using the following formulae which was given by Chacko (1965)

$$\text{Recruits (r)/ha} = 2500\sum_{i=1}^{n} r\ i\ /m$$

$$\text{Unestablished regeneration (u)/ha} = 2500\sum_{i=1}^{n} u\ i\ m$$

$$\text{Established regeneration (e) /ha} = 2500\sum_{i=1}^{n} e\ i\ /m$$

Where

n - Number of sampling units

m – Total number of recording units in survey

ri – Total number of recruits in each sampling unit

ui – Total number of unestablished plants in each sampling unit

ei – Total number of established plants in each sampling unit

$$\text{Weighted Average height (m)} = \frac{\text{Total height of unestablished regeneration + (Number. of established plants x establishment height)}}{\text{Total unestablished plants + total established plants}}$$

On the basis of above estimates following indices will be calculated:

$$\text{Establishment index } (I_1) = \frac{\text{Weighted average height}}{\text{Establishment height}}$$

$$\text{Stocking index } (I_2) = 1/2500 \times \frac{\text{Unestablished regeneration/ha}}{4} + \text{Established regeneration/ ha}$$

Established stocking per cent = 100 (I_1 x I_2)

Regeneration success (%) = Stocking index (I_2) X 100

Edaphic factors:

Following parameters were studied for accessing the edaphic factors affecting natural regeneration of different conifers

- Organic matter layer
- Physico-chemical properties

Organic matter layer (cm):

It was measured as depth of the column from top of humus layer to the

point under humus where soil exists.

Physico-chemical properties:

Mridaparikshak – A mini lab developed by ICAR-Indian institute of soil science (IISS), Bhopal in 2015 will be used for estimation of soil organic carbon (walkely and Black, 1954), Soil PH (Jackson, 1973), EC, available Nitrogen (Subbiah and Asija, 1956), available Phosphorus and available Potassium(jackson, 1973).

Result and Discussion:

The present investigation for regeneration studies were carried out on the basis of recruits, unestabished, established and regeneration success at four different blocks namely Khaipora, Tangmarg, FerozporaBaderkut in Gulmarg Forest Range. The data of various regeneration compounds are presented in table 2 which are described below:

The regeneration ability of any species is a vital factor in determining its ability to produce its off-springs and is ruled by number of factors. The natural regeneration of a tree species largely depends on the production and germination of seeds and the establishment of seedlings and saplings Rao (1998). The pattern of population dynamics of seedlings, saplings and adults of a species can reveal the recruitment profile, which is used to define their regeneration status. The results recorded pertaining to natural regeneration are interpreted and correlated to the literature to understand the regeneration status of conifers in different blocks of Gulmarg forest range. The present study revealed a total of four conifer species.

Regeneration status was analyzed using the methodology of Chacko (1965).

The perusal of data in Table 2 and Table 3reveal that natural regeneration of conifers were present at all the blocks except for *Taxus contorta* which was present only in Khaipora and *Cedrus deodara* which was present at Tangmarg and Baderkut. The presence of recruits, unestablished and established plants of all the conifers were present at their respective sites with the exception of *Cedrus deodara* which were absent in Tangmarg but present in Baderkut. But in case of *Taxus contorta* established plants could not be found. Of all the species found in Khaipora among recruits, unestablished and established, percentage of *Abies pindrow*was higher (55.74%). Similarly, percentage of *Pinus wallichiana*was higher (46.15%) in Tangmarg. Among the Species that were found in Ferozpora percentage of *Abies pindrow*washigher (40.00%). In Baderkut percentage of *Picea smithiana*was higher than other species (50.00%). The regeneration of species varied at different elevations which are in accordance with the study conducted by Gupta (1996). The lesser number of recruits, un-established and established regeneration at lower altitude may be attributed to high biotic interference (grazing, trampling by the animals and human settlement). The lesser number of recruits, un-established and established regeneration at lower altitude may be attributed to high biotic interference (grazing, trampling by the animals and human settlement). Similar trend was reported by Mir (2016) while working on Betula forest in Northwest Himalayas, Lanker *et al.* (2010), while working on Natural regeneration status of the endangered medicinal plant, *Taxus baccata,* in

northwest Himalaya. Similarly, Table 3 reveals that the maximum weighted average height (271.71), Establishment index (1.35), Establishment stocking per cent (9.06) was obtained at Ferozpora, while as Maximum Stocking Index (0.26) was obtained at Baderkut. The results obtained are within the range of Gatoo (2021) who obtained similar range while working on Natural regeneration status of Betula in Sangla valley of Indian Himalayas, Gupta (2019) while working on Natural regeneration status of Indian hazelnut in western Himalaya of Himachal Pradesh. Lower values of weighted average height, Establishment index, Stocking Index, Establishment stocking per cent might be attributed to the overexploitation of the species for timber, it could also be attributed to lower incidence of solar influx in the area, as supported by the findings of Niemann (1992) and Seidling and Constein (1998) who investigated the importance of light for yew survival. Highest regeneration success (26.58 %) was recorded at Baderkut and the minimum regeneration success (19.81) was recorded at Ferozpora (Table 3). Among species the highest regeneration success was obtained for *Abies pindrow*atKhaipora (11.22 %) and at Ferozpora (7.27*).* whereasmaximum regeneration success was obtained for *Pinus wallichiana* (9.78) at Tangmarg block and for *Picea smithiana* (14.29 %) at Baderkut. The results were in conforimity with the findings of Sharma (2006), Gupta (2007), Lanker (2007) and Malik *et al.* (2012). The regeneration of trees generally depends upon the ability of trees to provide sufficient quantity of seeds, their ability to germinate and grow as seedlings and survive in the under-canopy environment, where soil moisture

and light may often be limiting Kozlowski (1971), Good and Good (1972). A number of factors measured to be responsible for absence or poor natural regeneration such as thick layer of humus/depth of organic matter layer Gordon (1970), Troup (1921), Parnell (1930), Taylor *et al.* (1934), Glover (1936) Mahendru (1936) Dhillon (196) Kaushik (1954), Datta (1958), Kaul (1970) Sufi (1970) Rattan (2011) continuous grazing Redcliffe (1906) Troup (1921) Flewett (1930) Yadav (1963) Sufi (1970) and low germination capacity of the seeds.

It is evident from Table 4 that regeneration success has a significant positive correlation with Light intensity (0.75), pH (0.71), Electric conductivity (0.85), Organic carbon (0.94), available nitrogen (0.99) and available potassium (0.76) while as Organic matter layer (-0.97) and available phosphorous (-0.81) has a significant negative correlation. The findings from our study got support from the findings of Colaona and Giannini (1971), Singh (1983) and Pengshalin*et al.* (2006), where they have reported that depth of organic matter has indirect relationship with regeneration success. The findings also got support from Puri (1955) while studying the Himalayan conifer. Simple correlation coefficient results are in conformity with the finding of Filipiak and Komisaraek (2005) who reported potassium content and organic carbon in soil has positive effect on the regeneration of silver fir and Gatoo *et al.* (2020) who reported organic carbon, pH, solar influx, nitrogen and potassium in soil has a positive effect of regeneration of Silver fir and *Betula utilis.*

Table 2: Existing regeneration status of different tree species in different sites of Gulmarg Forest Range

Species	Recruits/ha		Unestablished/ ha		Established/ ha		Density/ha
	Number	Per cent (%)	Number	Per cent (%)	Number	Per cent (%)	
Khaipora							
Picea smithiana (Wall.)Boiss.	1250.00±37.50	31.39	373.75±13.17	28.85	74.25±3.44	33.11	200.00
Abies pindrow Spach	1986.67±80.83	49.88	622.92±21.95	48.08	125.00±3.75	55.74	280.00
*Pinus wallichiana*A.B.Jacks.	498.33±17.56	12.51	249.17±8.78	19.23	25.00±0.75	11.15	100.00
Taxus contorta Griff.	247.50±11.46	6.21	49.83±1.76	3.85	0.00±0.00	0.00	60.00
Total	**3982.50**	**100.00**	**1295.67**	**100.00**	**224.25**	**100.00**	**640.00**
Tangmarg							
Abies pindrow Spach	1000.00±30	37.38	250.83±6.29	32.26	100.33±2.52	30.77	200.00
*Pinus wallichiana*A.B.Jacks.	1300.00±39	48.60	376.25±9.44	48.39	150.50±3.77	46.15	160.00
Picea smithiana (Wall.)Boiss.	375.00±11.25	14.02	150.50±3.77	19.35	75.25±1.89	23.08	180.00
Aesculus Indica (Wall.exCambess.)	0.00± 0.00	0.00	0.00±0.00	0.00	0.00±0.00	0.00	80.00
Robinia pseudoacacia L.	0.00±0.00	0.00	0.00±0.00	0.00	0.00±0.00	0.00	60.00
Cedrusdeodara(Roxb.exD.Don) G.Don	0.00±0.00	0.00	0.00±0.00	0.00	0.00±0.00	0.00	100.00
Total	**2675.00**	**100.00**	**777.58**	**100.00**	**326.08**	**100.00**	**780.00**
*Pinus wallichiana*A.B.Jacks.	551.83±13.84	19.47	200.67±5.03	42.11	125.42±3.15	33.33	160.00
Abies pindrow Spach	2006.67±50.33	70.80	125.42±3.15	26.32	150.50±3.77	40.00	200.00
Picea smithiana (Wall.)Boiss.	275.92±6.92	9.73	150.50±3.77	31.58	100.33±2.52	26.67	180.00
Total	**2834.42**	**100.00**	**476.59**	**100.00**	**376.25**	**100.00**	**540.00**
Baderkut							

*Pinus wallichiana*A.B.Jacks.	275.92±6.92	11.58	100.33±2.52	9.52	50.17±1.26	12.50	100.00
Picea smithiana (Wall.)Boiss	602.00±15.10	25.26	326.08±8.18	30.95	150.50±3.77	37.50	160.00
Abies pindrow Spach	1505.00±37.75	63.16	627.08±15.73	59.52	200.67±5.03	50.00	180.00
Cedrusdeodara(Roxb.exD.Don) G.Don	0.00±0.00	0.00	0.00±0.00	0.00	0.00±0.00	0.00	100.00
Total	**2382.92**	**100.00**	**1053.49**	**100.00**	**401.34**	**100.00**	**440.00**

Table 3: Establishment and Stocking data for different tree species in different sites at Gulmarg Forest Range

Species	Weighted average height (cm)	Esatblishment Index(I1)	Stocking Index (I2 final)	Established Stocking Per cent (I1xI2x100)	Regeneration Success
Khaipora					
Picea smithiana (Wall.)Boiss.	36.36	0.18	0.06	1.21	6.70
Abies pindrow Spach	36.87	0.18	0.11	2.07	11.22
*Pinus wallichiana*A.B.Jacks.	21.62	0.10	0.03	0.37	3.49
Taxus contorta Griff.	2.50	0.01	0.0005	0.006	0.49
Total	**97.36**	**0.48**	**0.21**	**3.67**	**21.92**
Tangmarg					
Abies pindrow Spach	59.91	0.29	0.06	1.95	6.52
*Pinus wallichiana*A.B.Jacks.	59.90	0.29	0.09	2.92	9.78
Picea smithiana (Wall.)Boiss.	69.58	0.34	0.04	1.57	4.51
Aesculus Indica (Wall.exCambess.)	0.00	0.00	0.00	0.00	0.00
Robinia pseudoacacia L.	0.00	0.00	0.00	0.00	0.00
Cedrus deodara (Roxb.exD.Don) G.Don	0.00	0.00	0.00	0.00	0.00
Total	**189.39**	**0.94**	**0.20**	**6.45**	**20.81**
Ferozpora					

*Pinus wallichiana*A.B.Jacks.	78.96	0.39	0.07	2.77	7.02
Abies pindrow Spach	110.68	0.55	0.07	4.02	7.27
Picea smithiana (Wall.)Boiss.	82.07	0.41	0.05	2.26	5.51
Total	**271.71**	**1.35**	**0.19**	**9.06**	**19.81**
Baderkut					
*Pinus wallichiana*A.B.Jacks.	68.59	0.34	0.03	1.03	3.01
Picea smithiana (Wall.)Boiss.	66.38	0.33	0.09	3.08	9.28
Cedrus deodara (Roxb.exD.Don) G.Don	0.00	0.00	0.00	0.00	0.00
Abies pindrow Spach	51.40	0.25	0.14	3.67	14.29
Total	**186.34**	**0.93**	**0.26**	**7.78**	**26.58**

Table 4: Site characteristics of different conifer forest stands at Gulmarg Forest Range

Site name	Regeneration success	Light Influx (%)	Litter layer (cm)	pH	Electric Conductivity	Organic Carbon (%)	Nitrogen (kg/ha)	Phosphorus (kg/ha)	Potassium (kg/ha)
Khaipora	21.92	28.08	1.70	6.8[a]	0.90	0.35%	218.70	22.34	13.00
Ferozpura	19.81	19.36	4.50	6.4	0.70	0.25%	175.00	36.64	10.00
Baderkut	26.58	28.78	0.50	6.8[a]	0.94	0.41%	287.50	20.00	22.35
Tangmarg	20.81	16.79	3.80	6.5	0.75	0.29%	200.00	28.60	19.34
CD	**0.34**	**0.36**	**0.45**	**0.091**	**0.0135**	**0.0094**	**3.32**	**0.40**	**0.36**

CONCLUSION

The maximum numbers of recruits, unestablished and established plants were found for *Abies pindrow* at all the sites with the exception at however unestablished plants of *Pinus wallichiana* were found to be highest at Ferozpora. Highest establishment stocking per cent and regeneration success was found for *Abies pindrow* at Khaipora, Ferozpora and Baderkut while as for *Pinus wallichiana* at Tangmarg. Overall regeneration success was found to be highest at Baderkut followed by Khaipora while as the lowest regeneration success was found at Ferozpora respectively. The main factors responsible for poor regeneration seem to be higher organic matter layer and available phosphorus.

Simple correlation study reveal that the regeneration success has a significant positive relationship with Light Intensity, pH, Electric conductivity, organic carbon, available nitrogen and available potassium while as litter layer and available phosphorous has a significant negative correlation with regeneration success.

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