

Regeneration status on the afforested bank of Manasbal lake, Kashmir

Nasir Rashid Wani, Arshad Hussain Mughal

Faculty of Forestry, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Shalimar (J & K) India

nasirwani2012@gmail.com

Abstract: The study was carried out on the North-Western afforested bank of Manasbal Lake, Kashmir with the objective of studying regeneration status of tree and shrub species. After survey of the entire area, eight quadrats of size 2 x 2 m for trees and 1 x 1 m for shrubs were laid out on either side of the base line in a staggered fashion after every 200 m. During the course of study, *Robinia pseudoacacia* figured at top among all the tree species in terms of number per hectare at recruit, seedling and sapling stage. Maximum average height and average collar diameter in all the three stages viz., recruits, seedlings and saplings respectively was also recorded in *Robinia pseudoacacia*. Minimum number per hectare in recruits, seedlings and saplings respectively was recorded in *Ulmus wallichiana* with an average height and average collar diameter at sapling stage. Among shrubs *Cytisus scoparius* ranked first in terms of number per hectare in recruits, seedlings and saplings. However, *Berberis pseudoumbellata* was far better than any other shrub species in terms of average height and average collar diameter in all the three stages viz., recruits, seedlings and saplings.

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1. Introduction

Regeneration simply means the renewal of a forest crop by natural or artificial means. The regeneration status is carried out to study the regeneration of a particular area in terms of recruits, seedlings, saplings, etc. Regeneration is very important for the perpetuation of the forests which are so essential for the existence of human life on the one hand and practice of scientific forestry on the other. Natural regeneration occurs on a forest site when young trees begin to grow there without having to be planted. Sometimes seeds have been dispersed in the area by wind, water or by birds. Natural regeneration of forest trees depends on several important growth conditions such as the availability and dispersion of fertile seed in the area, the availability of soil moisture, temperature, light and freedom from diseases and harmful insects. The regeneration survey is very important in scientific forestry and is generally carried out at the time of revision of working plans with a view to compare natural regeneration in any regenerating area at the end of the working plan with that of in the beginning to evaluate the effects of operations carried out during the working plan period and to prepare a stock map of an area proposed to be regenerated and to prescribe correct silvicultural treatment for various parts on the basis of the status of the regeneration in them as well as to serve as basis for comparison at the end of the plan. Regeneration in forest occurs in the form of recruits, seedlings, saplings and poles. Sapling and poles can be considered as established regeneration. The natural

regeneration, obtained in the forest under the various systems is generally hidden under herbs and shrubs. Therefore, its ocular estimate is generally inaccurate. In the absence of 100 per cent enumeration, reasonably, accurate assessment of natural regeneration can be obtained by regeneration survey which is defined as "A survey for the assessment of established and unestablished regeneration, generally by sample enumeration" (Dwivedi, 1993). Total enumeration is not possible and therefore only 2 to 4 per cent enumeration is carried out. In mountainous area it is carried out by topographical units. In flat terrain it is done in strips. For this a base line is laid down and parallel survey lines of 100 m or 200 m are drawn at right angles to this. Regeneration survey is done in 2 x 2 m squares on both sides of the survey lines.

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 (Grubb, 1977). The population structure of a species in a forest can convey its regeneration behaviour (Saxena and Singh, 1984). The population structure, characterized by the presence of sufficient population of seedlings, saplings and adults, indicates successful regeneration of forest species, and the presence of saplings under the canopies of adult trees also indicates the future composition of a community (Khan et al., 1987). Regeneration status of trees can be predicted by the age structure of their populations (Tripathi and Khan, 2007). Regeneration of a particular species is poor if seedlings and saplings

are much less than the mature trees. The study of regeneration of forest trees has important implications for the management of natural forests, and is one of the thrust areas of forestry. Regeneration is the process of silvigenesis by which trees and forests survive over time (Bhuyan et al., 2003). Research in this field contributes to planning, conservation and decision making in forest resources management programmes. This study is an attempt to understand the regeneration status at the watershed level.

2. Material and methods

2.1 Study area

The afforested bank of Manasbal Lake is located at 70°-40' East longitude and 34°-15' North latitude at an elevation of 1,583 meters above sea level and is about 30 km North of Srinagar city. The maximum temperature of the study site touches as high as 31°C in the month of July while as minimum temperature drops as low as -4°C in the month of January. The annual precipitation of the area is about 700 mm and most of the precipitation is received in the form of snow during winter months. The site is located on the North-Western banks of Manasbal Lake and was taken up for afforestation by the Faculty of Forestry, SKUAST-K in the year 1992. During afforestation twelve tree species were planted in the area viz., *Acer negundo*, *Aesculus indica*, *Ailanthus altissima*, *Albizia julibrissin*, *Catalpa bignonioides*, *Cedrus deodara*, *Cupressus torulosa*, *Populus deltoides*, *Prunus armeniaca*, *Robinia pseudoacacia*, *Salix alba* and *Ulmus wallichiana*. The area is about 1.6 km in length while as its width ranges between 40-50 meters. After survey of the entire area, quadrats of different sizes, 8 each for trees and shrubs were laid for regeneration status. The details of quadrats laid for regeneration status are as under:

- A base line was laid length wise through the centre of the whole area.
- For regeneration status of trees, 8 quadrats of size 2 x 2 m were laid on the either side of the base line in a staggered fashion after every 200 m.
- Similarly for regeneration status of shrubs, 8 quadrats of size 1 x 1 m (Kent and Coker, 1992) were also laid within tree quadrat in a similar fashion.

2.2 Estimations

In each respective quadrat of trees and shrubs, total count of recruits, seedlings and saplings was done for each species and their height and collar diameter was also recorded. Regeneration status, was thus assessed in terms of

- Recruits (1-15 cm)
- Seedlings (16-100 cm)
- Saplings (101-300 cm)

3. Results and discussion

Earlier the afforested bank of Manasbal Lake was bare and barren and was prone to soil erosion. The preservation and enhancement of the natural beauty on its bank is of prime importance. The ever growing anthropogenic activities have brought about a serious threat to the floral and faunal diversity in and around its bank. Subsequently the issues like demarcation of its boundaries, laying out of areas for new schemes viz-a-viz., afforestation, social forestry, regeneration of species and rehabilitation of the catchment areas have assumed great importance. In the present study, aim was to carry out the regeneration status of different species on the bank of Manasbal Lake which were planted some 14 years ago and also to see the impact of afforestation on floral diversity.

3.1 Regeneration status of trees

The regeneration status of trees on the afforested bank of Manasbal Lake was carried out so as to identify recruits, seedlings and saplings of different tree species present in the area (Table 1).

3.2 Recruits

The maximum number of recruits per hectare was recorded in *Robinia pseudoacacia* (3438) followed by *Ailanthus altissima* (3125) and in *Celtis australis* (2500). Minimum number of recruits per hectare (625) was recorded in *Ulmus wallichiana*. The maximum average height (9.28 cm) and average collar diameter (0.19 cm) was recorded in *Robinia pseudoacacia* followed by *Ulmus wallichiana* which recorded an average height of 8.79 cm and a collar diameter of 0.18 cm. *Ailanthus altissima* recorded a height and collar diameter of 8.65 and 0.17 cm, respectively. The minimum average height (7.12 cm) and average collar diameter (0.10 cm) was recorded in *Celtis australis*.

3.3 Seedlings

The maximum number of seedlings per hectare was recorded in *Robinia pseudoacacia* (3750) followed by *Ailanthus altissima* (3438), whereas, minimum number of seedlings per hectare was registered in *Ulmus wallichiana* (938). The maximum average height of 65.37 cm and average collar diameter of 0.52 cm was recorded in *Robinia pseudoacacia* followed by *Ulmus wallichiana* which recorded an average height of 60.12 cm and a collar diameter of 0.51 cm. The minimum average height (40.47 cm) and average collar diameter (0.32 cm) was recorded in *Celtis australis*.

3.4 Saplings

The maximum number of saplings per hectare was recorded in *Robinia pseudoacacia* (4063) followed by *Ailanthus altissima* (3750), whereas, minimum number of recruits per hectare (1250) was recorded in *Ulmus wallichiana*. The maximum

average height (160.95 cm) and average collar diameter (1.54 cm) was registered in *Robinia pseudoacacia*. The minimum average height (101.43 cm) and average collar diameter (1.12 cm) was recorded in *Celtis australis*. The maximum number of recruits, seedlings and saplings per hectare, average height and average collar diameter of *Robinia pseudoacacia* could be attributed to its vigorous growth and heavy root sucker ability and also good seed year after year (Luna, 2005). *Ailanthus altissima* also produces abundant viable seeds and is also fast growing. The poor number of recruits, seedlings and saplings per hectare of *Ulmus wallichiana* could be due to non viable seeds because 80 per cent of the seeds of *Ulmus wallichiana* are sterile and only 20 per cent are fertile. Low average height and average collar

diameter of *Celtis australis* could be due to its slowing growing nature (Singh, 1982).

There has been no study of this nature on the afforested bank of Manasbal Lake to support our findings. However, other authors elsewhere such as Sood and Bhatia (1991) reported higher density of seedlings and saplings as compared to other girth classes at sites dominated by pure conifers and mixed conifer broad leaved forest around Shimla, Himachal Pradesh. Pandey (2003) reported low density of seedling and sapling in a mixed oak conifer forest of central Himalaya due to biotic causes. Regeneration behaviour of tree species is characterised by their population structure in the ecosystem, which in turn depends upon the presence of adequate number of seedlings and saplings (Pande, 2006).

Table 1. Regeneration status of trees on the afforested bank of Manasbal Lake, Kashmir

S. No.	Species	Recruits (1-15 cm)			Seedlings (16-100 cm)			Saplings (101 -300 cm)		
		Number (ha ⁻¹)	Average height (cm)	Average Collar diameter (cm)	Number (ha ⁻¹)	Average height (cm)	Average collar diameter (cm)	Number (ha ⁻¹)	Average height (cm)	Average collar diameter (cm)
1.	<i>Acer negundo</i>	1875	8.10	0.11	2188	41.26	0.39	2500	112.54	1.18
2.	<i>Aesculus indica</i>	1563	7.86	0.14	1875	45.68	0.49	2188	117.21	1.20
3.	<i>Ailanthus altissima</i>	3125	8.65	0.17	3438	56.45	0.42	3750	128.38	1.26
4.	<i>Catalpa bignonioides</i>	1250	7.23	0.13	1563	42.51	0.46	1875	112.13	1.19
5.	<i>Celtis australis</i>	2500	7.12	0.10	2813	40.47	0.32	3125	101.43	1.12
6.	<i>Morus alba</i>	938	7.19	0.15	1250	47.84	0.35	1563	110.51	1.16
7.	<i>Prunus armeniaca</i>	2188	7.39	0.12	2500	50.96	0.37	2813	105.62	1.15
8.	<i>Robinia pseudoacacia</i>	3438	9.28	0.19	3750	65.37	0.52	4063	160.95	1.54
9.	<i>Ulmus wallichiana</i>	625	8.79	0.18	938	60.12	0.51	1250	145.36	1.48

3.5 Regeneration status of shrubs

The regeneration status of shrubs on the afforested banks of Manasbal Lake was also carried out so as to identify recruits, seedlings and saplings (Table 2). The maximum number of recruits, seedlings and saplings per hectare were recorded in *Cytisus scoparius* 6250, 7500 and 8750 respectively followed by *Rosa foetida*, which recorded 5000 recruits, 6250 seedlings and 7500 saplings per hectare. *Rubus hoffmeisterianus* recorded 3750 recruits, 5000 seedlings and 6250 saplings per hectare. Minimum number of recruits (1250), seedlings (1250) and saplings (2500) per hectare were recorded in *Berberis pseudumbellata*. The maximum average height in all the three stages i.e., recruits, seedlings and saplings was registered in *Berberis pseudumbellata* 8.14, 27.25 and 107.45 cm respectively followed by *Rubus hoffmeisterianus* 8.12, 25.81 and 104.31 cm respectively, *Rosa foetida* recorded a height of 7.96, 23.62 and 103.16 cm in recruit, seedling and sapling stage respectively. Minimum height was recorded in *Cytisus scoparius* i.e., 6.35, 19.53 and 101.62 cm in

recruit, seedling and sapling stage respectively. The maximum average collar diameter of recruits, seedlings and saplings was again recorded in *Berberis pseudumbellata* 0.28, 0.86 and 1.98 cm respectively followed by *Rubus hoffmeisterianus* which recorded a collar diameter of 0.24, 0.81 and 1.92 cm in recruit, seedling and sapling stage respectively. *Rosa webbiana* recorded a collar diameter of 0.20, 0.66 and 1.17 cm in recruit, seedling and sapling stage respectively. Minimum collar diameter was registered in *Cytisus scoparius* 0.19, 0.53 and 1.10 cm in recruit, seedling and sapling stage respectively. Maximum number of recruits, seedlings and saplings per hectare of *Cytisus scoparius* in all the three stages is due to the fact that the shrub was planted during afforestation and also it produces abundant seeds having good germination percentage. Maximum average height and average collar diameter of *Berberis pseudumbellata* is attributed to its fast growing nature while as minimum average height and average collar diameter of *Cytisus scoparius* could be due to its slow growth.

Table 2. Regeneration status of shrubs on the afforested bank of Manasbal Lake, Kashmir

S. No.	Species	Recruits (0-15 cm)			Seedlings (16-100 cm)			Saplings (101-300 cm)		
		Number (ha ⁻¹)	Average height (cm)	Average collar diameter (cm)	Number (ha ⁻¹)	Average height (cm)	Average collar diameter (cm)	Number (ha ⁻¹)	Average height (cm)	Average collar diameter (cm)
1.	<i>Berberis pseudumbellata</i>	1250	8.14	0.28	1250	27.25	0.86	2500	107.45	1.98
2.	<i>Cytisus scoparius</i>	6250	6.35	0.19	7500	19.53	0.53	8750	101.62	1.10
3.	<i>Rosa foetida</i>	5000	7.96	0.21	6250	23.62	0.74	7500	103.16	1.88
4.	<i>Rosa webbiana</i>	2500	6.39	0.20	3750	20.86	0.66	5000	102.31	1.17
5.	<i>Rubus hoffmeisterianus</i>	3750	8.12	0.24	5000	25.81	0.81	6250	104.31	1.92

4. Conclusion

- There were fourteen species of trees, five species of shrubs and twenty-nine herbaceous species.

- *Celtis australis* and *Morus alba* have been established naturally in the area probably due to dispersal of seed by birds.

- The species planted on the bank of Manasbal Lake has affected the microclimate of the area. Accordingly new, sciophytic species of trees and shrubs have grown under the cover of such species.

- The recruits, seedlings and saplings of *Robinia pseudoacacia* showed dominance over rest of the species existing in the area in respect of number per hectare, average height and average collar diameter.

- In regeneration of shrubs, *Cytisus scoparius* recorded maximum number per hectare in recruits, seedlings and saplings among rest of the species. But the maximum average height and average collar diameter was recorded in *Berberis pseudumbellata*.

Corresponding Author:

Nasir Rashid Wani

Faculty of Forestry, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Shalimar (J & K) India

E- mail: nasirwani2012@gmail.com

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