Survey of Tree Species Regeneration in Canopy Gaps Forests in North of Iran

Mir Mozaffar Fallahchah, Seyed Armin Hashemi and Amir Bonyad

Department of Forestry, Lahijan Branch, Islamic Azad University, Lahijan, Iran.

ABSTRACT

In this study, tree species regeneration and their diversity in gaps resulted from silvicultural practices were studied in a forestry plan of Caspian forests in northern Iran. By sprayer forest 35 gaps were classified into 3 groups of 100-200, 200-400, 300-400 sq meter and 5 gaps from each group, totaling 15, were randomly selected for further analysis. To study regeneration of tree species along two diagonals of the gaps, 2×2 micro plot devices were systematically planted within one meter distances. The study shows that with enlarging the gaps, richness and frequency of species has increased, however not in a specific order, which has to be taken into account in markings. Also in 1-2R gaps 34 species, in 2-3R gaps 35, and in 3-4R gaps 37 species were recorded. The comparison of specie frequencies showed that the number for small saplings in large gaps were greater and the number of Carpinus betulus, winged fruited Pterocarya fraxinifolia and Gleditschia caspica in these gaps are of significant differences with the other species.

Key words: Diversity, Gap, Regeneration, Caspian forests, Iran.

Introduction

Biodiversity has been regarded as a significant index in natural science and there has been significant attention to any factor decreasing biodiversity. Many scholars refer to biodiversity as the important index of the sustainable development. Preservation of biodiversity along with searching for the most suitable site and harvesting rule should be considered as the most important goal in forest planning [1]. In forest management a gap is a physical space created by falling of one or more trees [4,3]. [10] have studied the effect of creating gaps on natural regeneration and results showed that regeneration is dispersed and mostly belong to beech (Fagus orientalis ) and Ash- tree (Fraxinus) and also there appears to be no clear difference between gaps and canopied areas. [9] studied the effect of the harvesting on the forest structure. Through their comparison between unlogged, 6-month and 18-year post-harvest forest stands they noticed that there was little difference in tree species composition and diversity between treatments, stem densities of both saplings and trees in unlogged forest were significantly higher than those in forest sampled 18 years after logging. Their evidence suggests that inadequate recruitment of Entandrophragma cylindricum and E. utile, the principal timber species, to justify continued timber extraction. [16] conducted a study on the gap characteristics and their regeneration in old conifer forests in Japan. There was a 7% gap area with mean square of 43 m². Gaps smaller than 40m² were more than the gaps more than 200m². They concluded that shade-tolerant species such as Abies will regenerate before the gap formation, but the light-demanding species such as picea and Betula alba regenerate after the gap formation. Generally specific species, show a prominent preference regarding the gap size. [12] studied the utilized gaps and concluded that some species are more abundant by gap expansion and most of the gaps are occupied with a few number of pioneer species.In another study showed that with increase in altitude from sea level species richness decrease while species diversity and evenness continue to rise so that the maximum species diversity is observed at the altitude range of 100-700 meter above sea level and the least diversity of species is observed above 700 meter altitude [7]. Because of high ecologic potential of Forests in Iran, it seems that there is a high regeneration and plan diversity in this .Such important goal motivated the researcher to conduct a field study in this area.

Material and Methods

Corresponding Author

Mir Mozaffar Fallahchah, Department of Forestry, Lahijan Branch, Islamic Azad University, Lahijan, Iran.
The site of this study was under the coverage of the Forestry Plan "Narmash" which was started in total coverage of 1181 hectares since 1991 by the Natural Resource Administration of Roodsar, headquartered in north of Iran. About 1016 hectares of this plan which is divided into 27 parcels, is under harvest but 165 hectares of it is managed conservatory because of its high slope and rocky nature. The forests in this plan are located at the altitude of 120 - 950 m, between 50°17’10" and 50°14’40" east longitude and 37°30’20" and 36°58’ north latitude belonged to the middle sector of the forests area. Generally these forests are of Carpinus betulus species mixed with species such as Parrotia persica, Alnus subcordata, Fagus orientalis, Acer insigne, Acer cappadocicum, Diospyros lotus and Pterocarya fraxinifolia. Parcel No 122 (52 hectares) in eastern general orientation and parcel No 124 (48 hectares) in north eastern orientation which, harvested in 2001-2002 were selected for this study. Their lowest, highest and mean altitude were 550 m, 950 m and 700 m respectively (Narmash Forestry plan). Their mean annual evaporation rate was 844.9 mm, with the partial moisture of 91.05% and annual participation of 1257.5 mm mostly in autumn. The mean annual temperature in this site is 15.4 °C with minimum and maximum temperature of -7 °C and 37.5°C. In this study thirty five gaps in parcels 122 and 124 were defined and then classified in three small, medium and big size groups. Five gaps were randomly selected from each group, providing 15 gaps totally as the sample of the study [2]. For studying the vegetation coverage and tree species regeneration micro plats of (2×2 m²) were assigned in 1 meter distance of each other systematically (Fig. 1). [8] and concurrently, all gaps area were calculated based on the following equation [13].

\[ S = \frac{R_1 \times R_2 \times \pi}{4} \]

where \( R_1 \) is the bigger diameter and \( R_2 \) is the lesser diameter.

**Fig. 1:** The micro plats of (2×2 m²) were assigned in 1 meter distance of each other.

Data Analysis was performed through analysis variance method (in a completely random Block plan) by SPSS soft ware and Tukey and ANOVA Tests were performed for comparing the means. Different biodiversity indexes were calculated and analyzed by DIVERSE soft wares and Figures were drawn by Excel.

**Results and Discussions**

The results demonstrated that twelve tree species and 29 grass species were observed in these sites among which, 8 tree species were present in 100 - 200 m², 200 - 300 m² and 300 - 400 m² gaps. There were also 27, 28 and 29 grass species in 100 - 200 m², 200 - 300 m² and 300 - 400 m² gaps respectively among them, 6 tree species were in common between three gap levels. On the other hand, 22 grass species were in common in 100 - 200 m², 200 - 300 m² and 300 - 400 m² gaps. There was no shrub in the gaps. Also 300 - 400 square meter gaps according to Shanno-wiener, Simpson, N\(^2\) Hill's, N\(^1\)Mc-Arthur indexes in sequence with the amounts 2.499, 0.807, 5.194 and 5.65 show the most tree diversity compared to other gaps (figures 2,3,4 and 5).
Fig. 2: Mean and standard deviation of Shannon-winner diversity in different gaps.

![Fig. 2](image_url)

Fig. 3: Mean and standard deviation of Simpson diversity in different gaps.

![Fig. 3](image_url)

Fig. 4: Mean and standard deviation of N2 Hill diversity in different gaps.

![Fig. 4](image_url)

Fig. 5: Mean and standard deviation of N1 Mc-Arthur diversity in different gaps.

![Fig. 5](image_url)

Also from the viewpoint of evenness in tree layers the most amount is related to 300-400 square meters gaps (figure 6).
Fig. 6: Mean and standard deviation of Evenness in different gaps. 

The tree species richness also in the gaps compared to other studied gaps with the amount of 8 has the most amount (figure 7).

![Graph showing Evenness in different gaps.]

Fig. 7: Richness of Tree species in different gaps.

Also 41 tree and grass species were observed among which, 34 tree and grass species were in 100 - 200 m² gaps, 35 tree and grass species were in 200 - 300 m² gaps and 37 tree and grass species were in 300 - 400 m² gaps (Figure 8).

![Graph showing Richness of Tree species in different gaps.]

Fig. 8: Richness Vegetation species.

Table 1: The means comparison variance analysis in different gaps.

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Sum of Squares</th>
<th>Degree of Freedom</th>
<th>Mean of Squares</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>383558.902</td>
<td>2</td>
<td>191779.451</td>
<td>.041*</td>
<td>0.959</td>
</tr>
<tr>
<td>Within Groups</td>
<td>19428337.60</td>
<td>42</td>
<td>4625793.75</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>19466836.51</td>
<td>44</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

n.s = non-significant.

Analysis has shown that there was no difference in regeneration among different gaps (Table1). Although there was some insignificant difference in field observation and number of generations in species such as Carpinus betulus, Gleditschia caspica, Pterocarya fraxinifolia. There was also higher number of plants in big gaps possible because of good seedling procedures and more suitable ecologic situations. Tree species were seen in all small and medium size gaps and also in big ones, until the center of the gap. Most of seedling Frequency was noticed in big gaps and the least one were seen in small gaps. There was negligible difference in the number of seedlings in small and medium sized gaps. There was more species in medium and big gaps than in small ones, although in big gaps, there were more seedlings. There was no significant difference in diversity of tree species in different gaps. But the diversity and number of tree species were different since tree harvesting and decrease of canopy density increased the light in the field resulting in the increase of the number of light demanding species in wider gaps.. Based on Tukey test, there was no significant difference (P=0.05). in tree layer among three gaps , although apparently there was some difference possibly because of the presence of animal in the area, wood burglary and unsuitable trees marking in the site of the study. Such evidence is just the opposite of the studies conducted by Haddadi moghaddam (2007) and shaghaghi (1996) in Gorgan province, both of them conducted their studies in the forests located in
eastern region to Narmash forests. Light demanding species such as grass and Rosaceae were seen in all gaps. Referring to ANOVA analysis, there was no significant difference of richness and evenness among gaps (Table 2, 3).

| Table 2: The species evenness variance analysis in different gaps.
<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Sum of squares</th>
<th>Degree of freedom</th>
<th>Mean of squares</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>.009</td>
<td>2</td>
<td>.004</td>
<td>1.158**</td>
<td>0.376</td>
</tr>
<tr>
<td>Within Groups</td>
<td>.022</td>
<td>6</td>
<td>.004</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>.031</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

n.s = non-significant.

| Table 3: The species richness variance analysis in different gaps.
<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Sum of squares</th>
<th>Degree of freedom</th>
<th>Mean of squares</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>.222</td>
<td>2</td>
<td>.111</td>
<td>.121**</td>
<td>0.888</td>
</tr>
<tr>
<td>Within Groups</td>
<td>5.500</td>
<td>6</td>
<td>.917</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>5.722</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

n.s = non-significant.

Discussion:

The more the gaps size and the area, the more the seedlings, although this increase is not in a specific scheme and there is little increase in number of gaps up to a mean level, decreasing sharply after that level. Seedlings Richness is less in small gaps and Richness is increased along with the increase in gap surface. But this increase continues up to 300 - 400 m² level, decreasing after that. This evidence is similar to the results of study that was conducted by [11] who proposed that the woody species are more in gaps lower than 4 acre. Yamamato on the other hand considers the 2 arc gaps field as the best site for the growth of Fagus crenata. Results also show that, the size of the gap provides no significant impact on species diversity in tree layer but increases the diversity in grass layer leading to a Major role in forest stability.

References