http://www.pjbs.org

PJBS

ISSN 1028-8880

Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Pakistan Journal of Biological Sciences 10 (10): 1697-1702, 2007
ISSN 1028-8880

Investigation and Comparison of Natural Regeneration Structure of Forest Stands in Protected and Non-Protected Areas in Arasbaran

[1]Ahmad Alijanpour and [2]Ahmad Mahmoudzadeh
[1]Faculty of Natural Resources, Urmia University, Urmia, Iran
[2]Department of Biology, Urmia University, Urmia, Iran

Abstract: In this study, a part of Arasbaran forest stands in two protected and non-protected areas have been compared for quantitative and qualitative factors of regeneration. Thus, using aerial photographs of 1967 in the scale of 1:20000, the similarity of these stands was examined and the comparable stands were chosen. Afterward, 77 circle plots of 0.01 ha in protected area and in the same way 77 circle plots of 0.01 ha in non-protected area with a grid size of 250×250 m were established. In each plot, all species with diameter at breast height (dbh) from zero to 7.5 cm were measured. According to the results the number of regeneration average in protected area was significantly higher than that in non-protected area. Oak and Hornbeam regeneration percentages showed highest significant difference in the selected areas. Additionally, these two species have the highest mixture percentage. The regeneration structure in both areas includes high and coppice systems, but coppice is prevalent. In both regions cutting, branching and grazing are the most important destructive factors, and the effects of these factors are higher in non-protected area.

Key words: Arasbaran forests, protected area, non-protected area, regeneration, high and coppice

INTRODUCTION

One of the noticeable distinctiveness of natural resources is their capability to reclamation continuously. In forest stands because of their long term logging, this comes very effective. The revival and development of forest stands are inevitably dependant on quantitative and qualitative situation of its natural regeneration and in the case of continuous regeneration, permanent forest products are feasible. The Arasbaran forests are one of the forest sites of Iran which is considerable with refer to regeneration.

These forests spread out in an area of 164000 ha in the north west of Iran. These forests are conservational and play a very important role in national economy regarding, the routine harvesting and its environmental effects on water and soil resources conservation, the importance of plant and animal diversity of these forests and conservation of its genetic assets. Additionally these forests include protected and non protected areas, moreover In order to preserve genetic resources and biodiversity of its plant and animal species, about 72400 ha of these forests has been protected and conserved from 1972 (Alijanpour *et al*., 1999).

The aim of this study is the comparison of quantitative and qualitative situation of regeneration of forest stands in protected and non-protected areas. The results of the study were used to determine whether protection based management has been lead to positive structural changes in regeneration.

The management of coppice system forests for producing fuel, firewood and charcoal dates back to very ancient times. In European countries such as France, Germany and Italy several studies has been conducted on coppice forests. Extensive domestic and international literature review is the subject of the next part.

Alijanpour (1996) in order to study quantitative and qualitative analysis of Arasbaran forest stands in 2435 ha, with having recorded 182 circle sample plots of 0.5 ha area (diameter-limited = 7.5 cm) evaluated the average volume of forest stands per ha as 76 silve, the number average number of trees per ha as 990 and the number of regeneration per ha as about 5000 seedlings.

Nilsson *et al.* (1996) in order to study the effect of crown coverage, soil preparation and planting depth on sprout and early growth of Querus rubur in the south of Sweden planted of 6840 seeds of Q. rubur in the mentioned different treatment levels and finally concluded that crown coverage doesn't have significant effect on the sprout percentage of seeds. They suggested that the percentage of sprout in seeds planted in 5 cm depth is the highest and the effect of soil preparation and planting depth on sprout percentage is significant.

Jalali and Hossaini (2000) in order to investigate the effect of environmental factors on natural regeneration of Quercus Castanifolia in Sourdar forests in Mazandaran

Corresponding Author: Ahmad Alijanpour, Faculty of Natural Resources, Urmia University, Urmia, Iran

province, considered some characteristics such as altitude, slope, aspect, height, crown coverage, the quality of seed tree, litter thickness, number, diameter and the quality of Quercus Castanifolia seedlings in 20 sample plots of 1000 m^2 area. According to the results, there is a significant relationship between altitude, slope steepness, grass coverage percentage and the average tree diameter at breast height and the number of oak seedlings. They pointed out that with reduction in altitude slope steepness, grass coverage percentage and the number of oak trees, the oak regeneration will be higher.

Fuchs *et al*. (2000) selected two sites each 1000 ha; (in Rocky point and Marry Hill) where, Quercus garryana was dominate. They examined the effect of effective factors on first year sprout and livelihood rate of the seeds of Quercus garryana in forested area in southern part of Vancouver Island in British Columbia, Canada. They randomly placed 2700 oak seeds in three plantation treatments (on ground surface, into litters, into surface soil). After one year they showed that 53% of seeds was spoiled by animals and the livelihood rate of seedlings in almost all sites was more than 65%.

Amirghasemi *et al*. (2001) studied the structure of natural regeneration of Arasbaran forests in SutanChai basin. In this study 139 plots of 0.1 ha were selected and the number of regeneration in unit area and the percentage of regeneration mixture were recorded. According to this study Hornbeam and Oak had the highest mixture percentages with respectively 31.7 and 29.3% and the average height for sprout were determined as 3.7 m.

Aliarab (2004) studied silvicultural problems of oak (*Quercus castaneifolia*) regeneration in Noor in Mazandaran Province of Iran. A split plots design with seven different seed planting techniques (control, soil scarification, seeding, seeding with soil scarification and acorn sowing in 5, 10 and 15 cm depth) under 4 different canopy densities (30, 50, 70 and 90%) was made. After first growing season the results indicated, contrary to planting method and time, crown density had not significant effect on qualitative (vitality) and quantitative (emergence, height, collar root diameter and mortality) emerged seedlings characteristics. The best vitality of seedlings happened in 5 cm depth.

Alijanpour *et al*. (2004) compared forest stand in protected and non protected area for quantitative characteristics. They used 92 line samples with network size of 150×300 m in both rejoins. They showed that the number of trees and basal area in protected forest were significantly higher than that in non protected forest stands.

MATERIALS AND METHODS

Study area: Arasbaran region is located in northern part of East Azerbaijan province in North West of Iran (Fig. 1).

Arasbaran forests are mainly located in four hydrologic basins of namely: Kalibar Chay, Ilgene Chay, Hijilar Chay and Selen Chay. The study area has located in Kalibar Chay and Ilgene Chay basin. The amount of annual rainfall in these areas varies from 400-600 mm in

Fig. 1: Location of Arasbaran forest in North West of Iran

average. The number of foggy (mist) days in this area is numerous and plays a major role in increasing the water balance of the area. The percentage of relative humidity is highest in June with about 85%. The average annual temperature varies from lowlands (Aras river banks) to high mountains and is estimated to be 17 and 5°C consequently. Arasbaran region belongs to third geological era and main part of its lithological structure is consisted of lime and igneous stones. In forest areas soils usually include forest brown soil and calcareous brown soil. These soil types are mainly over lime rocks (Abbasloo, 1996).

Arasbaran with 1% of whole country contains 10% of plant species of Iran. That is, 1334 plant species of have been determined from this region, which are categorized in 493 genus and 97 families (Birang, 1996).

It is worth of mentioning that in Arasbaran area apart from local flora, several instances of Hircanium, west of Iran, Caucasian flora could be observed. Because of this, Arasbaran region has a particular importance in maintaining a collection of species from several regions. Thus, biodiversity of these forests are very rich and important. Meanwhile the research conducted in 2005.

Selection of forest stands for comparison: Comparison of protected and non-protected forest stands is liable where these stands had a comparable condition prior to protection plan. This helps to have a meaningful comparison after three decades. The similarities of two areas can be investigated using documents from of early 1970s. Arial photographs of 1968 in the scale of 1:20000 produced by military authorities can be used. By using some characteristics of these photos like tree density, crown coverage, color tone of forest types of Aynalu, Ermaniolen and Garmanab in protected forest stands and Chape daragh, Tazakand, Lomaislam in non-protected area were chosen for comparison (Zobeiry and Dalaki, 1995). The total area selected from protected and non-protected areas were 485.4 and 485.6 ha respectively.

Inventory: Preliminary inventory carried out using 30 circle sample plots of .01 ha which were selected from protected and non-protected forest stands by means of a 250×250 m inventory grid. In this inventory the species and number of regeneration in the plots were recorded. Using the standard deviation of this inventory, the number of main inventory plots was set to 77 in order to achieve a precision of 8% (Zobeiry, 2000).

Considering as in forest stand studies the acceptable plot area is the one which at least include 10-12 trees. Therefore, using forest measurement information and preliminary investigation on regeneration study area, the sample plots were set to 0.01 ha and the shape was decided to be circle (Zobeiry, 2000; Amirghasemi *et al*., 2001). Having a number of 77 sample plots and the total area of the study area in two forest stands, the size of grid calculated as 250×250 m. After establishing the inventory grid, topographic map of the region in the scale of 1:25000 was prepared and used to transfer the grid on the map with a size of 1×1 cm.

Traditional technique of light table and checkered paper was used to transfer the sample plots on topographic map. Finally, the plots were given identification codes and the map was prepared for using in the field.

Equipments like Sunto clinometers, compass, rope, tape meter, GPS and slope correction tables were used to locate the sample plots in the forest. After finding a plot, a circle with a predefined diameter and centre was drawn and all regenerations at breast height with below 7.5 cm diameter were counted and recorded (Zobeiry, 2000). An inventory form as below was used to register the information:

A: position of sample plots: Location of plots, slope, altitude from sea level, aspect, forest stands type and type of devastation (grazing, branching and girdling)

B: regeneration characteristics: species code, number, health situation of regeneration, coppice and high systems

C: the characteristics of nearest and thickest sprout of group in each sample plot.

Minitab statistical package was used to analyze the collected data such as the average number average of regeneration and its confidence limits, the mixture percentage of species, coppice and high system occurrence and health percentage of regeneration in two protected and non-protected areas. Moreover, this package is used to compare means and to examine normal distribution of data.

RESULTS

Comparison of regeneration number in study areas: Number per ha of regeneration in protected and non-protected areas according to counted regeneration in 0.01ha sample plots, the average regeneration in plots, standard deviation and confidence limits calculated for two areas (Table 1).

Therefore, the average number of regeneration in protected stands is limited between $5051<N<5598$ seedling per ha with a probability of 95%. These limits in non-protected areas is between $3667<N<4187$ seedlings per ha.

Table 1: The average number of regeneration and its confidence level

Characteristics	No. of plots	Total No. of regeneration	Average regeneration in plot	Inventory error	Confidence limit
Protected area	77	4101	53.25	±1.867	53.25±2.735
Non-protected area	77	3024	39.27	±1.3	39.27±2.6

Table 2: Comparison of mixture percentages of species in study area

Characteristic (%)	$\hat{t}$
Carpinus	5.38**
Quercus	3.82**
Acer	0.115^{ns}
Cerasus	1.034^{ns}
Taxus	0.727^{ns}
Others	9.67**

(5%, 152) = 1.96 t (1%, 152) = 2.57, n.s: non significant at above mentioned levels * significant at 5% probability, ** significant at 1% probability

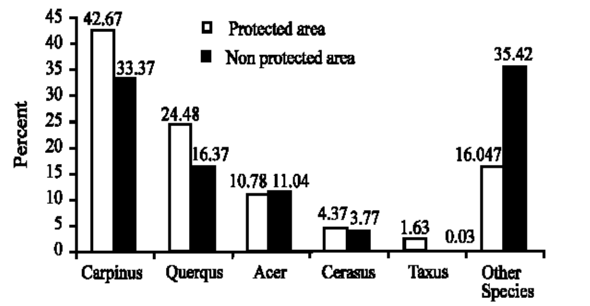

Fig. 2: The mixture percentage of species in two protected and non-protected areas Other species: *Fraxinus*, *Ulmus*, *Cornus*, *Viburnum*, *Crataegus*, *Pyrus*, *Juniperus*, *Sorbus*

T-test in Minitab package is used to compare the number of regeneration in two protected and non-protected areas. The estimated was 6.15 with degree of freedom of 152. Considering the table and the degree of freedom of 152 the extracted figure was 1.097. Thus, quantitatively with a probability of 95% the average regeneration in protected and forest stands is significantly more than that of non-protected areas. Minitab package is used to determine the distribution of data, so the results showed that the data is normally distributed.

Regeneration mixture percentage: The codes and the information about species type that recorded in .01 ha plots were used to estimate regeneration mixture percentage, and regeneration number in the plots (Fig. 1).

According to Fig. 2 Carpinus betulus had the highest mixture percentage in two protected and non-protected areas of respectively 42.67 and 33.37% and Taxus baccata had the lowest mixture percentage of respectively 1.63 and 0.03% relative frequency comparison test was used to compare mixture percentages of each species in two areas (Zobeiry, 2002) (Table 2).

The origin of regeneration: Arasbaran forests are mainly coppice system and the number of high in these forest stands is about 20% of whole the bases (Alijanpour *et al.*, 1999) (alijanpour, 2001). In this study, the origin of all regeneration (coppice or high) in sample plots was investigated and recorded in inventory form. In protected area total of 4101 regenerations in sample plots, only 1214 are highs. In non-protected area 990 regeneration from a total number of 3024 in sample plots were high and the remaining were coppice. Therefore, the high or coppice percentage of forest stands in two areas is the same as Fig. 3.

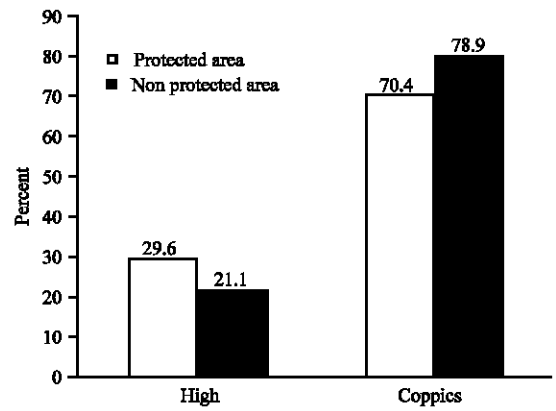

Fig. 3: The origin regeneration percentages in protected and non-protected areas

The comparison of percentages of coppice in two regions showed that with a probability of 95% there is a significant difference between coppice percentages in two regions.

The healthiness of regeneration: The healthiness of regeneration and destructive factors were investigated in the inventory. One-year and two-year seedlings have been damaged by grazing, plagues and diseases and bigger ones by branching and girdling (Fig. 4).

The investigation of regeneration healthiness in forest stands showed that the healthiness of regeneration in the protected area is significantly more than that of non-protected area.

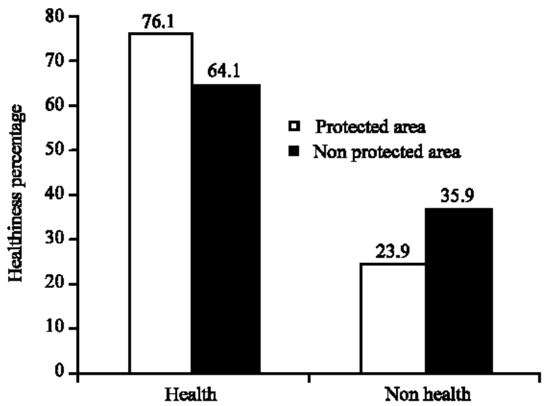

Fig. 4: The healthiness of regeneration in two protected and non-protected areas

DISCUSSION

In this research, we showed quantitatively that with a probability of 95% the average regeneration in protected forest stands is significantly more than that of non-protected areas. These results verify that conservational management in the past 35 years in Arasbaran has been lead to positive and quantitative changes in protected areas. This situation resulted from the reduction of destruction intensity, over population and reduction of grazing animals in protected areas. The obtained results by Amirghasemi (2001), support the fact that mean regeneration number increases in protected areas and decreases in non protected areas.

Comparison of regeneration percentages in two forest stands will lead to the clear conclusion that mixture percentage of valuable and prevalent species in seed bearers like *Carpinus* and *Quercus* in non-protected area has been decreased. With refer to Taxus, only one case in non-protected area was recorded. In contrast, other species (like; *Fraxinus*, *Lulus*, *Cornus*, *Viburnum*, *Crataegus*, *Pyrus*, *Juniperus*, *Sorbus*) showed an immense mixture percentage in non-protected area. Therefore, in non-protected area by logging and cutting of valuable species and seed trees the possibility of settlement of other species increases. While, according to Alijanpour (2004), mixture percentage of Carpinus and Quercus in mature stand is very high, but for other species is negligible.

The investigations of the regeneration in both areas are based on coppice and high systems with the dominance of coppice system. Dominance and frequency of coppice system shows the sprout ability of Carpinus, Quercus, main species which saved the existence of forest in spite of uncontrolled cutting. The percentage of coppice bases in protected area (70.4%) is significantly less than that of non-protected area (78.9%). This means that the evolution of forest stands started with coppice towards both high and coppice systems and by application and continuation of protection there has been a remarkable progress during the past 35 years. Settlement and germination of seeds of forest stands is prevalent, because the area offers a suitable soil condition regarding the physical, chemical and climatologically factors, but the uncontrolled grazing and the thickness of dead coverage of forest bed, a lot of seeds are being lost in the period of their growth and evolution. Moreover, the production of suitable seeds is insufficient because of the youth of groups sprout and the small number of seed bearers' bases.

Cutting, branching and grazing were three factors that concurrently had the most destructive effects on young stands. The severity of destruction in protected area was lower. Natural reclamation and rebuilt of these forest stands don't face a severe ecological problem and only economical, social and cultural factors exhibits themselves as, cutting, grazing of pats, land use changes of these stands and the increasing of cultivated areas, has endangered these forest stands and their future.

ACKNOWLEDGMENTS

My greatest thanks are extended to God, the creator who enabled me to finish this work. This work would not have been possible without supporting of Uremia University. I am grateful to: Mr. Abassloo, Mr. Safapour, Mr. Bayrami the experts of research center of natural resources and agriculture of Tabriz. More over grate thanks goes on Dr. Bernosi and Dr. Abghari.

REFERENCES

Abbasloo, A., 1996. Investigating the environmental need and quantitative and qualitative characteristics of qurecus and carpinus in Sutanchi basin of Arasbaran. M.S. Thesis, Tarbiat Modarres University, pp: 100.

Aliarab, A., 2004. Effect of soil scarification, seedling and seed planting on Oak regeneration under different canopy densities. M.S. Thesis, Tarbiat Modarres University, pp: 125.

Alijanpour, A., 1996. Investigating the quantitative and qualitative Arasbaran forests (case study in Sutanchi basin). M.S. Thesis, Tehran University, pp: 100.

Alijanpour, A., D. Nohorly and M. Chalabianloo, 1999. Arasbaran biosphere reserve, proceedings of Biosphere Reserve Conferences of Arasbaran, Iranian Environmental Department, Tabriz, pp: 85.

Alijanpour, A., 2001. Investigating and determination of optimum statistical methods at Arasbaran forests. Ph.D Thesis, Tehran University, pp: 165.

Alijanpour, A., M. Zobeiri, M.R. Marvimohajer and N. Zargham, 2004. A comparison of forest stand quantitative factors in protected and non protected areas in Arasbaran forests. Iranian J. Natural Resour, 57: 445-447.

Amirghasemi, F., K. Saghebtalebi and D. Dargahi, 2001. The study of natural regeneration structure in Arasbaran forests (Sutanchi basin). Iranian Forest and Popular Research Center, 259: 1-60

Birang, N., 1994. Azerbaijan Flora collection Project Reports, Agriculture Faculty of Tabriz University, pp: 350.

Fuchs, M.A., P.G. Krannitz and A.S. Harestad, 2000. Factors affecting emergence and first year survival of seedlings of *Garry oaks* (*Qercus garryana*) in British Colombia. For. Ecol. Manage., 137: 209-219.

Jalali, A. and M. Hossaini, 2000. Investigating the different physical factors on natural regeneration of Quercus castanifolia in Sarvedar, Noor. Daneshvar, 31: 69-74.

Nilsson, U., P. Gammel, M. Lof and T. Wcalander, 1996. Germination and early growth of sown Querc roburin relation in to soil preparation, sowing depth and prevention against predation. New Forest, 12: 69-86.

Zobeiry, M. and A. Dalaki, 1995. Principle of Arial Photograph Interpretation. 6th Edn., Tehran University Press.

Zobeiry, M., 2000. Forest inventory (measurement of tree and stand). Tehran University Press, pp: 401.

Zobeiry, M., 2002. Forest biometry. Tehran University Press, pp: 411.