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The radial and basal area increment estimation in natural oak stands in northern Zagros (case study: Nejou forests in Baneh)

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Key words: Oak (*Quercus infectoria*), Basal area Increment, diameter increment, basal area per hectare, Natural stand, Baneh.

Abstract

The diameter and basal area increments are calculated in a natural oak stands located in Nejo forest in Baneh. For the purpose of this research, a natural stand was chosen, after a field survey. The diameter at breast height (DBH) and height of trees were measured, at 40*40 meters sampling plots. The Point _Quarter method was then used to measure the diameter increment for the 10 years period. Finally radial increment, basal area increment, number of trees per hectare, dominant height and number of regeneration per hectare was estimated and related curves were drowned. The analysis of data shows the following results: Mean annual radial increment with bark and without bark were 2.84 and 2.46 mm corresponding. Mean annual basal area increment for individual trees estimated by specific tables was 8.63 cm^2.Mean basal area increment per hectare was 0.5818 m^2, Mean basal area per hectare was 23.697m^2 and density was 616 trees per hectare.

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Introduction

Zagros forests, is the largest forest area in the Iran and the production of this forests are not woody productions but in terms of environmental values, soil protection, water supply and non-wood forest products are so valuable and unique. The forest area in the past few decades due to reasons such as socio-economical conditions and the lack of comprehensive and efficient management is largely destroyed so they may be lose potential to offer their services. To resolve this problem, appropriate management actions based on people's participation is also essential. In order to evaluate the management, determine the damage and the process of regeneration establishment in a specific site, it is necessary to have some sites that in geographically position and forest conditions similar to nature forest, it is helpful to comparing the structure and dynamic processes areas, executive and practical programs need to guidance the forest management and conservation of biodiversity like nature forests process. In the study area due to the socio-economic structure, forest utilization is running but some stands exist that are random distribution in area whom because of specific reasons they remain natural and human interference and utilization in these stands is close to zero. In fact a kind of traditional forest management system based on local forestry knowledge is now running in this area so that this system are used extremely in these forests. If it will be possible to obtain some information from the remaining natural stands, it will be fasilate to evaluate the traditional forest management by compare the forest situations. We plan to achieve this goal by obtain information from the remaining natural stands.

Definition

Natural stand: stands that remain natural so human intervene and livestock entry is very low or zero.

The aim of this research is a study of radial and basal area increment estimation in natural oak stands in Nejou forests in Baneh in Northern Zagros

Material and methods

Study area

The study area belongs to the forest village located in the West Nejo city Baneh (Kurdistan) is located. Stand area of about 2.68 hectare, and the dominant slope was northwest and eastern, the dominant species was Quercus infectoria, the average altitude of stand 1680 meters and mean slope was 35% to 45%. The average annual rainfall in the area was 712.78 millimeters; based on Domarten method the climate was semi-humid.

Methods

In this study the 100% inventory method has done in sampling plot with 0.16 hectare area (40 × 40 meter), diameter and height of all trees were measured and were recorded in special prepared forms. To measure the diameter increment was measured by Hanss Arthur Meyer method that growth samples from control trees was extracted by an increment borer. The sample extract at DBH height of tree, then in the laboratory experimentally measured and radial increment during the past 10 years to accurately tenth millimeter measured, diameter increment and basal area increment will be calculated based on the previous prepared tables. To determine the control trees in the stand, a baseline parallel to the sides of the stand will be located in the north _ south. Based on baseline transect lines vertical to each other at regular intervals of 50 meters along the slope of the line. The first point on each transects completely random and the rest are taken at regular intervals of 40 meters from each other. Area surrounding each point divided into four quarters and in each quarter the nearest tree to sample point select as the control tree and the DBH, height, and thickness of bark were measured.

Results

Quantitative analysis of basal area per hectare

Radial increment

The diameter increment

In the 8 and 9 columns of Table of bark factor K equal to 1.34 is used.

The relationship between diameter increment without bark and diameter classes

Mean diameter increment without bark and with bark was corresponding 2.84 and 2.46 millimeter was calculated.

Table 1. Statistics of the basal area of stand.

quantity	basal area m²	No.	hectare
Total basal area	63/51	----	----
Mean basal area in plot	3/791	----	----
Mean basal area in hectare	23/70	----	----
Area	----	----	2/68
Total trees	----	1651	----
Total trees in hectare	----	616	----

Table 2. Table radial increment of control trees.

diameter Class	Diameter with bark	Twice thickness of the bark	Diameter without bark	Mean radial increment Without bark (10 years)
	centimeter	centimeter	centimeter	millimeter
10	11/70	2/12	9/58	10/28
15	14/21	3/01	11/20	11/42
20	19/82	3/25	16/57	12/04
25	24/08	3/40	20/68	12/08
30	30/08	3/78	26/30	11/85
35	35/88	3/88	32/00	13/30
40	40/42	4/08	36/33	14/45
45	43/64	4/24	39/40	14/32
50	49/50	4/58	44/93	13/78
65	66/75	5/40	60/35	11/50
70	69/55	6/00	63/55	9/85
75	73/50	6/70	66/80	9/60

Obtained by the best foreseen model (Figure 1) can be estimated increment of the diameter (Table 4).

The basal area increment

According to these calculations, the mean annual basal area increment of an individual tree was 8.63 cm² and the mean annual basal area increment per hectare was 0.581869 square meters.

Table 3. Table diameter increment calculated on stand.

1	2	3		4		5		6	7	8	9
Diameter classes	No. in diameter class	Diameter With bark		Diameter Without bark		Radial increment Without bark In period		diameter Without bark At middle period	annual diameter increment Without bark 5×6	Diameter with bark At middle period	annual diameter Increment with bark 7×8
	n	centimeter $\sum Di$	$\overline{Di}$	centimeter $\sum di$	$\overline{di}$	centimeter $\sum Li$	$\overline{L}$	centimeter $X=\overline{di}-\overline{L}$	centimeter $i=\frac{2\overline{L}}{10}$	centimeter X=K×X	centimeter I=K×i
10	6	70/2	11/70	57/5	9/58	6/17	1/028	8/552	0/206	9/698	0/233
15	5	71/0	14/21	56/0	11/20	5/71	1/142	10/058	0/228	11/406	0/259
20	10	198/2	19/82	165/7	16/57	12/04	1/204	15/366	0/240	17/425	0/272
25	9	216/7	24/08	186/1	20/68	10/87	1/208	19/470	0/241	22/079	0/273
30	6	180/5	30/08	157/8	26/30	7/11	1/185	25/115	0/237	28/480	0/269
35	5	179/4	35/88	160/0	32/00	6/65	1/330	30/670	0/266	34/780	0/302
40	6	242/5	40/42	218/0	36/33	8/67	1/445	34/888	0/289	39/563	0/328
45	5	218/2	43/64	197/0	39/40	7/16	1/432	37/968	0/286	42/056	0/324
50	4	198/0	49/50	179/7	44/93	5/51	1/378	43/548	0/275	49/383	0/312
65	2	131/5	66/75	120/7	60/35	2/30	1/150	59/200	0/230	67/133	0/261
70	2	139/1	69/55	127/1	63/55	1/97	0/985	62/565	0/197	70/949	0/223
75	1	73/5	73/50	66/8	66/80	0/96	0/960	65/840	0/192	74/663	0/218

Table 4. Table of annual diameter increment calculated from the model fitting.

diameter classes	10	15	20	25	30	35	40	45	50	55	60	65	70	75
annual diameter increment	0/236	0/259	0/278	0/292	0/303	0/309	0/312	0/310	0/305	0/295	0/281	0/264	0/242	0/216

Table 5. Calculation table of basal area increment of the stand.

1	2	3	4	5	6	7	8	9
Diameter classes	basal area	Difference of basal area	Corrected difference of basal area	basal area Increment In result of 1 cm. diameter increment	annual diameter increment of individual tree (model)	Annual basal area increment of Individual tree 5×6	No. of trees per hectare	Total Annual basal area increment per hectare 7×8
cm	Cm2	Cm2	Cm2	Cm2	centimeter	Cm2	No.	Cm2
5	19/63	58/90						
10	78/54	98/17	78/54	15/71	0/236	3/708	143/7	532/84
15	176/71	137/44	117/81	23/56	0/259	6/102	134/3	819/50
20	314/16	176/71	157/08	31/42	0/278	8/735	158/6	1385/37
25	490/87	215/98	196/35	39/27	0/292	11/467	94/0	1077/90
30	706/86	255/25	235/62	47/12	0/303	14/277	37/7	538/24
35	962/11	294/52	274/89	54/98	0/309	16/989	25/4	431/52
40	1256/64	333/79	314/16	62/83	0/312	19/603	4/5	88/21
45	1590/43	373/06	353/43	70/69	0/310	21/914	4/5	98/61
50	1963/50	412/33	392/70	78/54	0/305	23/955	3/7	88/63
55	2375/83	451/60	431/97	86/39	0/295	25/485	3/7	94/29
60	2827/43	490/87	471/24	94/25	0/281	26/484	1/9	50/32
65	3318/31	530/14	510/51	102/10	0/264	26/954	1/5	40/43
70	3348/45	569/41	594/78	109/96	0/242	26/610	1/9	50/56
75	4417/86	608/68	589/05	117/81	0/216	25/447	0/7	17/81
80	5026/55							

Discussion

The natural stand Increment annual diameter curves indicate that trees in the first years of life, reaching a diameter of 35 to 40 centimeters, annual increment diameter with bark have a gradual increase in with soft slope. After reaching the diameter of 40 centimeters the diameter increment is reduced gradually. Increase and decrease in the curve of growth is a gradual process with a low slope implies that the stand increment is normal and natural. The diameter increment trends affecting the basal area increment so that basal area of the stand up to diameter 55 centimeters increased and then decreased. Totally the result of study shows:

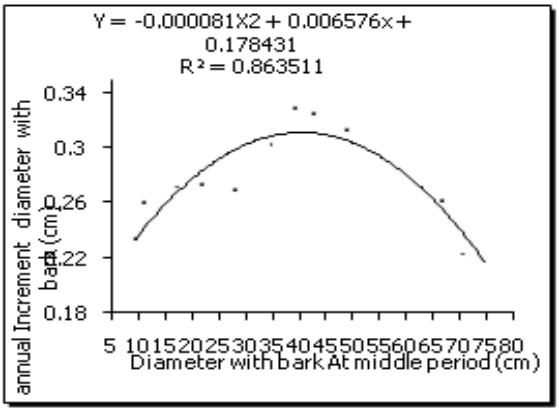

Fig. 1. The relationship between diameter increment without bark and diameter classes in natural stands.

1. Mean annual diameter increment with bark and without bark were 2.84 and 2.46 millimeters, respectively.

2. Mean annual increment basal area per hectare and per plot, respectively, 0.58 and 0.93 square meters respectively.

3. Mean annual increment basal area for individual tree 8.63 square centimeters.

4. Mean increment basal area per hectare and per plot, respectively, 23.70 and 3.80 square meters, and respectively.

5. The number of trees per hectare was 616.

6. K Coefficient (diameter with bark than diameter without bark) was 1.134.

The relationship between the DBH and annual diameter increment was Y = -0.000081X2 + 0.006576x + 0.178431.

Conclusion

The study was done in Kurdistan Region and Nejo village of Baneh city. Due to the large distribution of *Quercus infectoria* forest area and different climatic and edaphic conditions conducting research in similar areas is important. Doing such studies in other parts of Zagros help to determine annual increment with respect to the soil and site conditions for each areas and obtain a comprehensive result about Zagros forest increment. It is necessary to do this kind of study do for other dominant oak species (*quercus brantti* and *quercus libanii*). there are also other studies on this species in different regions of the Zagros be done in order to introduce forest increment and also determine the damaging effect of human utilizing, livestock and other pressures on the growth be specified.

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