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Investigation of Sampling Method Application with Fixed Plot in Sampling of Coppice Forests (Case Study: Oak Coppice Forests in Central Zagros)

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Abstract: The aim of this research was investigation of sampling method application with fixed plot in sampling of Zagros coppice forests (West of Iran). Zagros forests confronted with much damage before. These damages had due to destroying areas of forests and retrogradation formed in the other areas. Structure of these forests changed because of last years damages and coppice forests were formed, finally. Collection of appropriate qualitative and quantitative information is necessary for principle management and programming. An inventory network with 200×400 m dimension designed in study area for this research. Then, numbers of 40 witness plots with 1 ha area were produced. Samplings were performed by circle form sample plots with 10 ARE area (1 ARE = 100 m^2 area) and square form sample plots with 15, 20, 30, 40 and 50 ARE areas within mentioned 1 ha plots. The obtained results of sampling different methods for estimation number of group coppice per hectare and crown covering were compared with results of witness plots. Analysis of Variance (ANOVA), compare means test (LSD) at $p<0.05$ and percent of standard error (E %) were used for comparison of the means. Results of this research showed that number per hectare parameter of 20 ARE plots had significant differences with results of witness plots. The other plots had no significant differences viewpoint number per hectare parameter. The minimum and maximum of E% were observed in circle form sample plots with 10 ARE (E% = 10.82%) and 50 ARE (E% = 8.12%) areas, respectively for number per hectare parameter.

Key words: Sampling, coppice, oak, Lorestan

INTRODUCTION

Zagros sites are extensive areas of Zagros continues mountainous that included a region with 1300 km in length and average width of 200 km in Iran. Zagros forests classified as semi-arid forests and with 5 million ha areas have devoted 40% of Iran forest areas. These forests have the most influence in water securing, soil conservation, climate adjustment and economical and social equilibrium of region (Sagheb Talebi *et al*., 2005).

The forests are more than 500 years old in term of pollenology studies (Jazerehei and Ebrahimi Rostagh, 2003). Pay attention to disturbing of these forests in last years, its structures are disturbed and same as coppice forests (Adeli *et al*., 2008). Collection of appropriate qualitative and quantitative information's is necessary for principle management and programming. Therefore, forest inventory has essential role for estimation of present conditions and future programming (Eshagh Nimvary *et al*., 2003).

Designing of sampling system is a main component in forest inventory that will collect the advantage data (Tokola and Shrestha, 1998). Pay attention to, a partial area of forest total is sampled, therefore, production of a tiny error in this area will effect manifold in forest areas total (Zobeiry, 2002) thus, obtained data of sampling should be sufficient precession and accuracy content.

Adeli *et al*. (2008) used number of 48 plots with 4 ha area (including 13 subs-plots for each) in Zagros forests for determining appropriate area of sample plot for estimation of crown covering and richness. They have proposed 100 ARE area plots in regions with 25-50%

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density for estimate of crown covering. Erfani Fard *et al*. (2008) compared distance sampling of T-square and dispersal index in distance pattern analysis of Zagros forests and T-Square method was recognized as appropriate method of sampling. Spark and Masters (2002) compared five sampling methods vis-à-vis fixed plots with 3.64 and 5.64 m radiuses, square plots with central point, variable plots, strip transect and 10×10 m square plots in three forest stands in Oklamaha southeast regions and the result indicated that using fixed and variable plots methods are more appropriate in regions with diverse density and different sizes of tree stems.

Amini *et al*. (2007) investigated the precession of random inventory method with 10 ARE area sample plots in estimating the number and distribution of basal area at breast height and volume and number per hectare in diameter classes in north forests of Iran. They found that obtained results had reliable precession for hornbeam and fuel wood species. Zobeiry (2000) proposed plots with 10-15 and 10-20 ARE areas for sampling of coppice and high forests of oak, respectively. Regarding to above information, the aim of this research was investigation of obtained data accuracy of sampling method with fixed area that is one of common sampling methods in mentioned region.

MATERIALS AND METHODS

Study area: Study area is located on northern part of Lorestan Province (that is component of Zagros forests ecosystem) between east longitude 48° 20' 36"-48° 23' 09" and north latitude 33° 39' 57"-33° 38' 59" and 1500-2700 m above sea level. Mean annual precipitation is 540 mm. The dominant forest species in study area are *Quercus persica* (J. and Sp.) Zohary, *Cratagus pontica* C. Koch and *Pyrus boissieriana* Buhse. Covering percent is variable between 1-83% and in expended areas these forests are degraded. This study was carried out in the summer of 2008. Sample plots were designed using an inventory network with 200×400 m dimensions (Fig. 1) and 40 witness plots with 1 ha area were selected at random.

Sampling was done using sample plots with 15, 20, 30, 40, 50 ARE areas within 1 ha plots, while circle and square forms sampling plots were used in plots with areas less and more than 12 ARE, respectively (Fig. 2) (Zobeiry, 2000).

Tree inventory was carried out in the designed sample plots. The species name and characteristics, diameter of crown, coppice or high forest were recorded in inventory forms. Analysis of Variance (ANOVA),

Fig. 1: A partial of used inventory network in region

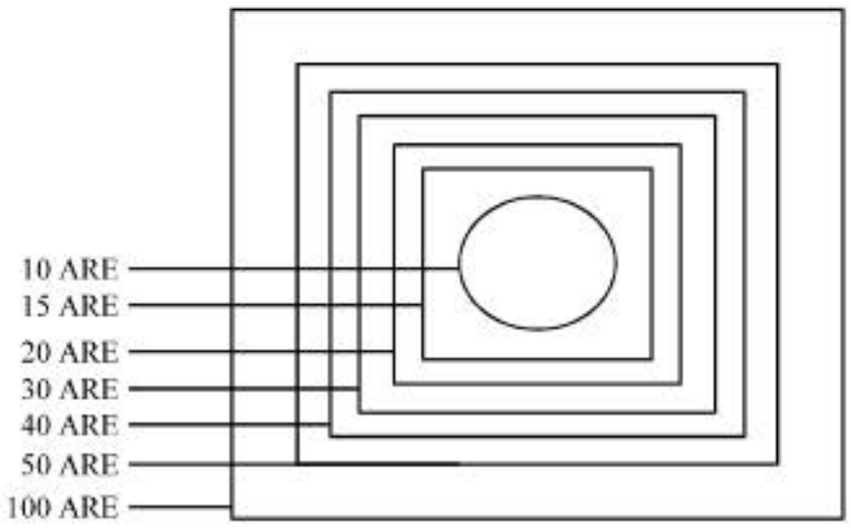

Fig. 2: The formation of used sample plots

compared means test (LSD) and percent of standard error (E%) were calculated in SPSS software program.

RESULTS

Three forest dominant trees were observed and these include *Quercus persica* constituting 97.8%, while *Cratagus ponica* and *Pyrus boissieriana* constituted 2.2% (Fig. 3). Stand density was 140 group coppices per hectare and 40% viewpoint crown covering.

Analysis of variance was used for comparison of obtained resulting 10, 15, 20, 30, 40, 50 ARE areas with witness plots. There were no significant differences between number and crown covering (%) per hectare with witness plots (Table 1).

Also, LSD test showed that number per hectare of 20 ARE plots had significant differences (at confidence limit of 95%) with results of witness plots. The other plots had no significant differences viewpoint number per hectare (Fig. 4).

Standard error (E%) were calculated for obtained results of different sample plots. Minimum and maximum E% were observed in circle from sample plots with 10 ARE (E% = 10.82%) and 50 ARE (E% = 8.12%) areas, respectively for number per hectare factor (Fig. 5). Also, highest value of E% was (12.6%) observed in circle from sample plots with 10 ARE area and the least (E% = 11.64%) observed in 50 ARE plot for the estimation of crown covering parameter (Fig. 6).

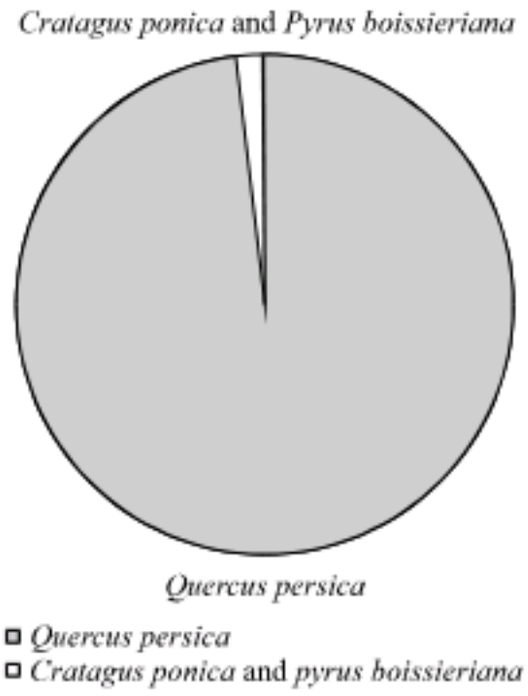

Fig. 3: Presence species in study area

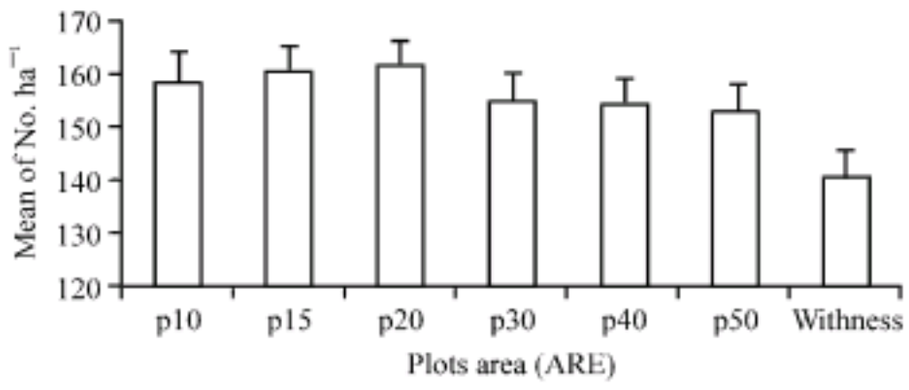

Fig. 4: Compare means of estimated number per hectare with different sample plots

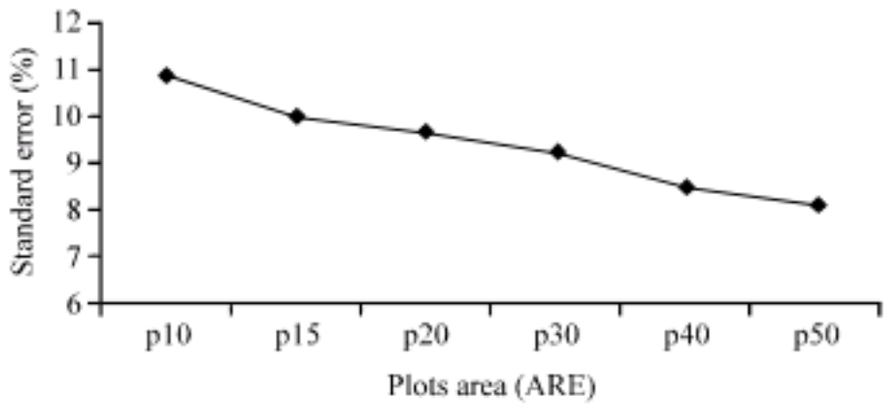

Fig. 5: Standard error (E%) of obtained results in estimation of number per hectare

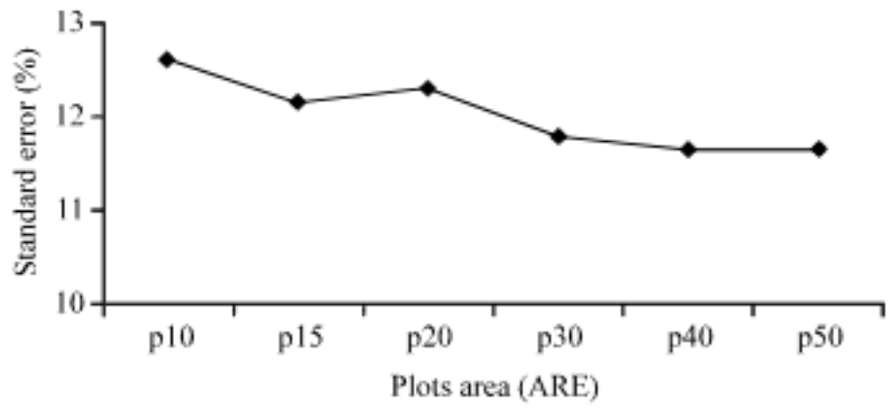

Fig. 6: Standard error (E%) of obtained results in estimation of crown covering area

Table 1: Analysis of variance for number per hectare and crown covering parameters

Variable factor	Sum of square	df	Mean square	F	Pr>F
No. per hectare					
Between groups	11888.64	6	1981.440	0.967	0.448
Within groups	559169.3	273	2048.239	-	-
Total	5710558	279	-	-	-
Crown covering					
Between groups	1392111	6	232018.537	0.114	0.995
Within groups	6E+008	273	2026953.29	-	-
Total	6E+008	279	-	-	-

DISCUSSION

The result of LSD test showed significant differences between obtained results of 20 ARE plots and witness sample plots viewpoint estimation of number per hectare. Pay attention to low value of this different ($p = 0.04$) thus, this difference can be relinquished. Investigation of standard error (E%) for different sample plots showed the precession of obtained results by sampling is increased with increasing of sample plots areas. This subject was observed for estimation of number per hectare and crown covering as the most and least of standard value (E%) were observed in plots with 10 and 50 ARE areas, respectively.

Gray (2003) resulted that the deviation of actual value in the estimation of density per hectare of trees are deleted and number of species are reduced with increasing sample plot area. The standard error was more irregular in estimation of crown covering compared to estimation of number per hectare, due to the existence of errors in inventory of crown covering areas and connection of group coppice crown each other and clumped structure in region.

Adeli *et al*. (2008) proposed the plots with 100 ARE area for estimation of crown covering in Zagros forests with 25-50% crown density. It can be deduced that this different in his research is because of, he just used of sample plots with circle form and also, his research region was located in southern Zagros regions that has different density and more richness. Zobeiry (2000) proposed the plots with 10-15 ARE areas for sampling of west coppice forests (in Iran). Comparison of obtained results of sample plots with 10 and 15 ARE areas for estimation of number per hectare and crown covering area parameters by LSD test confirmed this subject in this research.

Erfani Fard *et al*. (2006) proposed the 8 ARE plots as the least plot area for estimation of crown covering area in Zagros forests. He observed no significant differences between obtained results of 10 ARE plots with circle form. In this research don't observed any significant difference between estimated crowns covering with 10 ARE plots and witness sample plots, also.

Eshagh Nimvary *et al*. (2003) observed no significant differences between obtained results of 20 ARE plots with the results of complete inventory for estimation of number per hectare and crown covering area, that is confirmed by results of this research. Kulow (1966) proposed plots with 1/5 acer area (1acer = 4047 m^2 area) for sampling of his study area that area of these plots were equal to 10 ARE plots of this research.

Pay attention to, the results many of plots were confirmed for estimation of investigated factors and also, the precession of obtained results were increased with increasing plots area. Therefore, it is imagined that cost factor is a limit factor for selection of plots area, because of inventory costs will increase with increasing plot area. Finally, selection of sample plot area should be according to mentioned accuracy and precession.

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