

## Evaluation of different sampling method to study of tree density (tree/hectare) in the Zagros forest

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### ABSTRACT

For maintaining of Zagros forests role in wild life, water and soil conservation, the suitable solutions and methods for assessing the existing conditions and planning for management of this forests should be given. To detection of suitable sampling method to study tree density in the northern Zagros forest, Blake forest, in Baneeh region, Kurdistan province, and west of Iran was selected. 40 square sample plots one hectare (100×100 m) were selected and perfect inventoried. In every sample plot the position of tree, kind of species and number of species were recorded. In order to study of tree density (tree/ha) different sampling methods (rectangular sample with 20×50 m and 10×50, random sampling method with 40, 50 and 60 circle sample plots which everyone was 1000 m<sup>2</sup>) compared the perfect inventory. To determination of suitable sampling for study of tree density used the %E<sup>2</sup> ×T indexes. To compare the tree parameter in the every sampling methods and perfect inventory used the t-test analysis. Data analyzing was done by SPSS16 software's. Results showed that the rectangular sample with 20×50 m sample methods was the best methods and have maximum of accuracy. Overall results showed that the rectangular sample with 20×50 m sampling methods was (have minimum of time and %E<sup>2</sup>×T criteria) the suitable methods to study of density (tree/ hectare). Authors suggested to study of tree density (tree/hectare) in the northern zagros forest used the rectangular sample with 20×50 m sampling methods.

**Key words:** Kurdistan province, Sample methods, Tree density northern zagros forest

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### INTRODUCTION

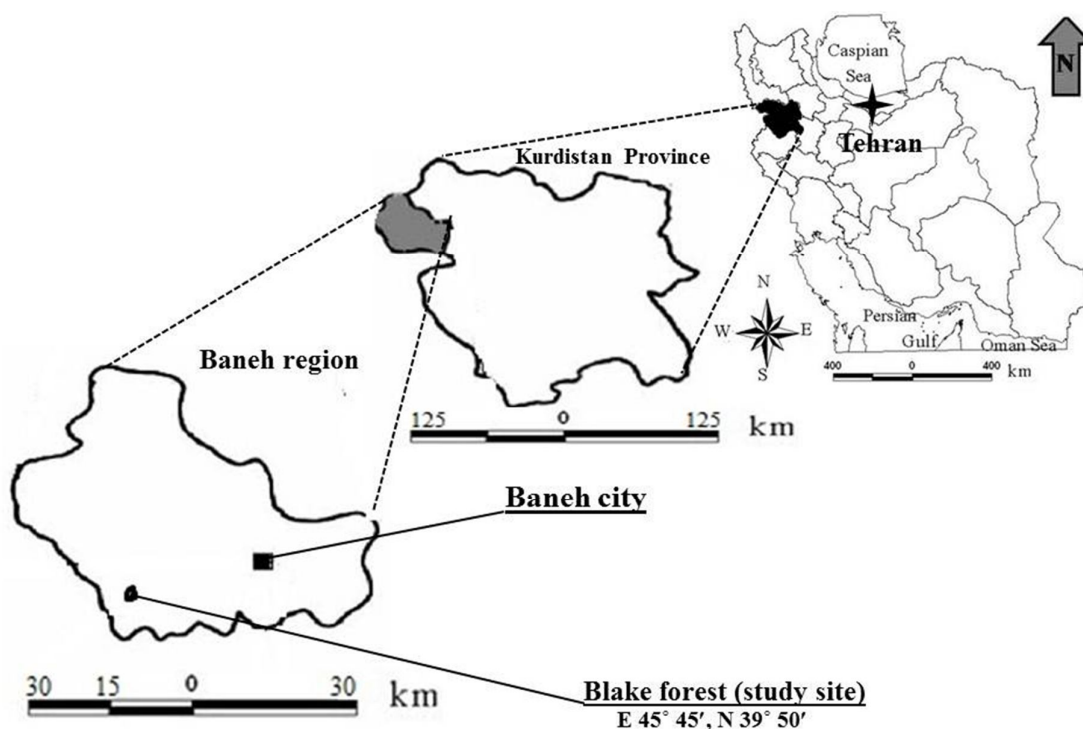
I.R. of Iran is located in the North Temperate Zone from 25 to 40 latitude and 44 to 63 longitude degrees, with a total area approximately 1,650,000 Km<sup>2</sup> (Haidari *et al*, 2012a). Forests cover about 12 million ha in Iran (Haidari *et al*, 2012b). Including 5 million ha in the mountainous Zagros region. The Zagros Mountains are divided into two parts: northern and southern. The northern Zagros is consisted of the growing site of *Quercus infectoria* Oliv. And also *Q.libani* Oliv. And *Q.persica* J. & Sp. (*Q.brantii* Lindl.) (Haidari *et al*, 2012c). Species are found in this part. However, the southern Zagros is included *Q.persica* site which it extended to Fars province (i.e., 29° 5' N). The northern Zagros is wetter and cooler than the southern one (Pourbabaei and Navgran, 2011). The researcher studied and Comparison of Randomized-Systematic Sampling with Circle Shape Plot and Transect Method, Based on

Precision and Cost. Parameters evaluated were number per hectare, crown cover and basal area. Results showed that random-systematic sampling with circle shape plots is of less error than transect method in all cases (Nimvari *et al*, 2002) researcher determination of the most appropriate transect length for estimation of quantitative characteristics in Zagros forests and results showed that transects with 140m length had the most precision for estimating the above-mentioned parameters (Naghavi *et al*, 2009). The researcher Comparison of circular plot and transect sampling methods in the Zagros Oak Forests, for this purpose and based on cost and precision ( $E\%^2 \times T$ ) criterion. Results showed that the more suitable method for these forests in west of Iran is the circular sample plot with 1000m<sup>2</sup> area (Heidari *et al*, 2009). The researcher study of vertical and horizontal forest structure in Northern Zagros Forest and results showed that Overall results showed Blake forest was two forest story and *Quercus libani* Oliv and *Quercus infectoria* Oliv were the most dominant woody plants and located in over story (Haidari *et al*, 2013). The aim of our study was comparing the accuracy and precision of several of the sampling methods to study of tree diversity and tree parameters in northern zagros forest.

## MATERIAL AND METHOD

### Site description

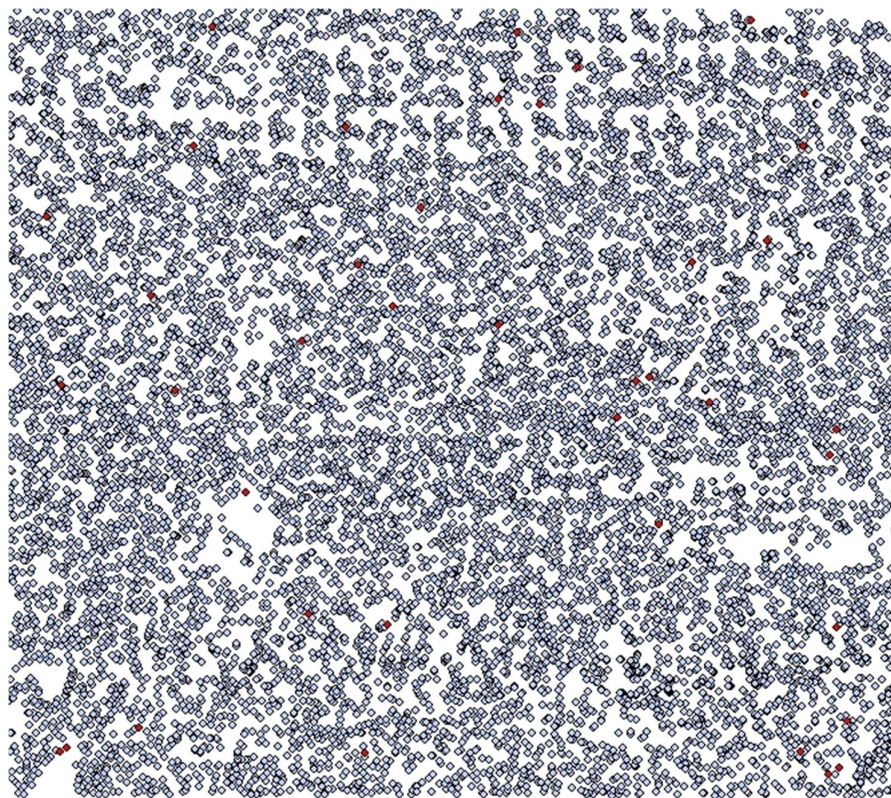
This research was investigated in the Baneh region, northern Zagros forest, and western Iranian state of Kurdistan (Figure 1). Blake Village is located in west of Baneh city and 40 (600×675 meter) hectare of conventional territory of this village was selected (Haidari, 2011).



**Figure 1.** Study site location in the Kurdistan Province, Zagros region, Western Iranian state of Iran.

## Analysis

In this study 40 square sample plots one hectare (100×100 m) were selected and perfect inventoried (Figure 2) and in every sample plot the position of tree, kind of species and density were recorded.



**Figure 2:** dispersion of tree in the study area (600×675 m)

The data of perfect inventory was transmitted in ARC GIS software and the dispersion map of trees was extract. To determination of suitable sampling method for study of tree density (tree/hectare) compered the different inventory methods to perfect inventory. In order to study of tree parameter different sampling methods include: rectangular sample with 20×50 m and 10×50 in the 100× 100 m net, random sampling method with 40, 50 and 60 circle sample plots which everyone was 1000 m<sup>2</sup> and Transect (with 100 meter length in the 100× 100 m net, and this sampling methods compared with perfect inventory. To determination of suitable sampling for study of tree density and crown cover (%) used the %E<sup>2</sup>×T criteria. To study of (tree/hectare) in the study area, tree characters include density and kind of species were recorded. To compere the tree parameter in the every sampling methods and perfect inventory used the t-test analysis.

### Comper the different sampling methods by used the accuracy and costs index:

After the statistical analysis and detected of significant and non-significant different between sampling methods use the compering the accuracy and costs index in the base of below formula:

$$A = \%E^2 \times T$$

T: total time of sampling    E: Standard error

Each of sampling methods was lowest A ( $\%E^2 \times T$ ) index is suitable sampling methods. Data analyzing was done by SPSS16 software's.

## RESULT AND DISCUSSION

Results of perfect inventory showed that five tree and shrub species observed in the study area. Species in the study area include the *Quercus libani* Oliv, *Quercus infectoria* Oliv, *Acer monspesolanum* L, *Pistacia atlantica* Desf, *Crataegus* sp and *Pronus* sp. *Quercus libani* Oliv was the most dominant tree and shrub plants.

**Table 1.** List of Shrub species in the studied areas

no	Scientific name	Family
1	<i>Quercus libani</i> Oliv.	Fagaceae
2	<i>Quercus infectoria</i> Oliv.	Fagaceae
3	<i>Acer monspesolanum</i> L.	Aceraceae
4	<i>Pistacia atlantica</i> Desf.	Anacardiaceae
5	<i>Crataegus</i> sp.	Rosaceae
6	<i>Pronus</i> sp.	Rosaceae

The shrub species belonged to four families were identified in the study area (Table 1) thus for the classes of rosacea, Fagaceae, Anacardiaceae and Aceraceae, two, two, one and one species were existed, respectively.

**Table 2: results of density (tree/hectare) in the different sampling methods**

Sampling methods	Number of sampling	Density (N/ha)	SD	Inventory error	Percent of Inventory error
Perfect inventory	40	296	57.19	-	-
Transect (with 50 meter length)	40	251	154.22	45.56	15.54
rectangular sample	40	303	43.22	16.12	6.68

with 20 m×50					
rectangular sample	40	305	65.33	32.12	8.56
with 10 m×50m					
random method with 40 sample	40	322	134.32	44.23	17.24
random method with 50 sample	40	319	120.54	35.34	14.23
random method with 60 sample	40	333	69.81	22.34	11.22

Table 2 showed that the rectangular sample with (20 ×50m) and (10 ×50m) have a maximum of accuracy, minimum of inventory error and nearest of density (tree/ha) in compare of real quantity (Perfect inventory). These sampling methods are suitable methods for study of tree density.

**Table 3:** results of t-test analysis to study of density (tree/hectare)

Sampling methods	Compare means		
	t	Sig.	results
Transect (with 50 meter length)	- 2.231	0.012	*
50×rectangular sample with (20 m)	-3.23	0.056	ns
50×rectangular sample with (10 m)	-0.768	0.312	ns
random method with 40 sample	-0.546	0.532	ns
random method with 50 sample	-0.902	0.412	ns
random method with 60 sample	-1.253	0.145	ns

\* Different letters indicate significant differences in 5% level ns. no significant differen

t

Results of table 3 showed that transect (with 50 meter length) is significant different from real quality (perfect inventory) and deleted in continues of study. Others sampling methods no significant different from real quality and was suitable sampling methods.

**Table 4:** comparing of the accuracy and cost between different sampling methods to study the tree density (tree/ha)

Sampling methods	time of sampling (minute)	percent of Inventory error	× T %E <sup>2</sup>	suitable sampling method
Perfect inventory	7776	-	-	-

rectangular sample with 50 20×m	542	6.68	3621	First
rectangular sample with 10×50 m	452	8.56	3869	Second
random method with 40 sample	600	17.24	10344	fifth
random method with 50 sample	720	14.23	10246	fourth
random method with 60 sample	860	11.22	9649	tertiary

Results of table 4 showed that by used the ( $T \times \%E^2$ ) criteria best suitable sampling was rectangular sample with 20 m×50 methods. Collection of appropriate qualitative, quantitative and diversity data is necessary for proper management and planning (Naghavi *et al*, 2009). For maintaining of Zagros forests role in wild life, water and soil conservation, the suitable solutions and methods for assessing the existing conditions and planning for management of this forests should be given (Karamshahi *et al*, 2012). To determine a suitable method, based on precision and cost, of inventory in Western oak forests (Nimvari *et al*, 2002). rectangular sample with 20×50 m and 10×50 in the 100× 100 m net, random sampling method with 40, 50 and 60 circle sample plots which everyone was 1000 m<sup>2</sup> and Transect (with 100 meter length in the 100× 100 m net, and this sampling methods compared with perfect inventory. The tree and shrub species that identified in the studied region belonged to six trees and shrub species in four families. The presence of six tree and shrub species in 40 ha area indicates not considerable diversity in the study area (table 1). Rosaceae family had high number of species (table 2). *Quercus libani* Oliv was the most dominant woody plants for the class of tree. Table 2 showed that the rectangular sample with (20 ×50m) and (10 ×50m) have a maximum of accuracy, minimum of inventory error and nearest of density (tree/ha) in compere of real quantity (Perfect inventory). These sampling methods are suitable methods for study of tree density. Results showed that the rectangular sample with (20 ×50m) and (10 ×50m) have a maximum of accuracy, minimum of inventory error and nearest of density (tree/ha) in compere of real quantity (Perfect inventory). These sampling methods are suitable methods for study of tree density (table 2). After the statistical analysis and detected of significant and non-significant different between sampling methods use the compering the accuracy and costs index ( $\%E^2 \times T$ ) to determination suitable sampling methods. Results showed that by used the ( $T \times \%E^2$ ) criteria best suitable sampling was rectangular sample with 20 m×50 methods (table 4). Overall results showed that the rectangular sample with 20 m×50m sampling methods were the suitable methods was suitable to study of density (tree/ha) and Heidari *et al*, 2009 emphasis this this results. Authors suggested to study of tree density (tree/hectare) in the northern zagros forest used the rectangular sample with 20 m×50m sampling methods.

## CONCLUSION

Overall results showed that to study of tree density (tree/hectare) in the northern zagros forest used the rectangular sample with 20 m×50m sampling methods.

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