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Research Article

Evaluation of *Crategus* sp. spatial pattern in the Central Zagros Forest

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ABSTRACT

The spatial pattern of trees can possibly indicate stand history, population dynamics, and species competition. This research investigated in the Chahartagh forest reserve, Ardal region, chaharmehal and Bakhtiari Province, Central Zagros forest, and southwest Iranian state. In this study 53 hectare of the study area was selected and perfect inventory. Information includes the position and kind of tree, height and two diameters of crown were recorded. To study of spatial pattern used the quadrat sampling methods. Inventory method designed in the base of systematic-randomize methods by use the nearest individual, and inventory accrued in the five treatment and measured 5×32 (total 160) sample (measured the nearest individual). To analysis of spatial pattern used the distance method and Johnson & Zimmer and Pielou indexes. *Data analyzing was done by Ecological Methodological software's.* all applied indicators showed a clumped pattern for *Crataegus* sp chahartagh forest reserve in Central Zagros region, and Western Iranian state of Iran.

Keywords: Spatial pattern, *Crataegus* sp, Chahartagh forest reserve, Chaharmehal and Bakhtiari Province, Johnson & Zimmer index.

INTRODUCTION

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 Km2 (Haidari *et al*, 2013 e; Haidari *et al*, 2012c). A large section of interior is characterized by arid basins. Climatic variations are also great in Iran. The main variation is between the dry, desert interior region and humid Caspian coastal region (Mohajer, 2004 and Haidari *et al*, 2012d; Bazyar *et al*, 2013a). With due to attention to climatic conditions of Iran, 65% area includes arid and semi-aired and degradation rapid of north and west, because of degradation of natural resources will cause to degradation agricultural lands and human environmental (Dastmalchi, 1998; Haidari *et al*, 2012e, Haidari *et al*, 2012f). Forests cover about 12 million ha in Iran (Haidari *et al*, 2012b, Haidari *et al*, 2012c), including 5 million ha in the mountainous Zagros region. The Zogros Mountains are divided into two parts: northern and Southern (Askari *et al*, 2013). 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 (Bazyar *et al*, 2013b; Parma and Shataee, 2013; Haidari *et al*, 2013c). Increasing

population, low level of development and high dependence of local communities on forests for their primary livelihood needs, are the main reasons of this destruction (Fatahii, 1994). Spatial pattern information for individual trees is increasingly sought by forest managers and modelers as means to improve the spatial resolution and accuracy of forest models and management scenarios (Wulder *et al*, 2004). There are three basic spatial patterns as following: clumped, random and uniform (Mitchell, 2005).The researcher used Hopkins index to determine spatial pattern of tree in the Zagros forests. He concluded that the trees were arranged in a clumped pattern (Heidari, 2006). The researcher studied of tree spatial pattern of Ghamishle (Kurdistan province) forest and results showed that clumped spatial pattern of tree in the study area (Basiri *et al*, 2006).The researcher studied the stand structure and spatial pattern of trees in mixed Hyrcanian Beech forests of Iran and results showed that spatial pattern in this forest are clump spatial distribution pattern in all layers (Habashi et *al*, 2007). The researcher Investigation on the Spatial Pattern of Trees in Zagros Forests and According to the total spatial pattern, 1,500 m2 circular sample plot was chosen as the most suitable plot to study spatial pattern of the study area (Erfanifard et al, 2008).The researcher studied of spatial pattern analysis in Persian oak forests on B&W aerial photographs and results showed that C index can detect the spatial arrangement of trees. Thereafter the index was used on the air photo of the study area that was made of B&W aerial photographs. The method suggested in this study provides a suitable approach for detecting the spatial pattern of trees in Zagros forests on B&W air photos (Erfanifard *et al*, 2009). The researcher studied of spatial patterns in untouched beech (*Fagus orientalis* Lipsky) stands over forest development stages in Kelardasht region of Iran and results showed that while the number of stems decreases from initial stage toward decay stage, the spatial pattern of trees in initial, optimal and decay stages are highly aggregated, random and slightly aggregated (Akhavan *et al*, 2010). The researcher Investigation of spatial pattern of wild pistachio (*Pistacia atlantica* Desf.) in Bayangan forests (Zagros forest) abd results showed that all indices related to plot samples indicated the clumped pattern for *Pistacia atlantica*. Among the distance indices used in this study, Eberhart and Heines indices showed clumped, C index showed regular and Hopkins index indicated random pattern for Pistachio. As a result, the spatial pattern of Pistachio is clumped (Safari *et al*, 2010). The researcher investigation on structure of oriental beech (*Fagus orientalis* Lipsky) stand at optimal stage in north of Iran. Results showed that the stand has a closed canopy cover and distribution of stem number per diameter class was more or less homogenous (Bell shape) with a semi even-aged structure. Using Ripley's *K* function, the distribution of trees within the stand was random (Hassani and Amani, 2010). The researcher Investigated pattern of Manna oak trees (*Quercus brantii* Lindl.) in Bayangan forests of Kermanshah province, zagros forest. All of the applied indicators showed a clumped pattern for *Quercus brantii* (Safari *et al*, 2010). The researcher studied the effect of traditional forest management practices in Havare khol pattern (Kurdistan province, Northern Zagros forest) on forest structure and results showed that DBH distribution graphs showed reduced uneven-aged young aged stand and spatial pattern of this forest was uniform to clumped pattern. Overall results showed the Havare khol Traditional Forest Management Practices lead to increase the young tree and regeneration (Zabiholahii *et al*, 2012). The researcher studied of Study of vertical and horizontal forest structure in Northern Zagros Forest and results showed that the DBH distribution graphs showed uneven aged stand and spatial pattern of this forest was uniform to random pattern. A traditional forest management practice in the Armardeh (Blake forest) has negative effect on the forest regeneration and increases the frequency of old trees (Haidari *et al*, 2013). Determination of trees spatial patterns in each development stage illustrates the dynamic of stands during the time and can provide valuable information on the underlying processes, particularly in case of uneven-aged forests (Akhavan *et al*, 2010). The aim of this research was study of tree spatial pattern in chahartagh forest reserve, Ardal

region, chaharmehal and Bakhtiari Province, Centarl Zagros forest, and southwest Iranian state.

MATERIALS AND METHODS

Site description

This research was investigated in the chahartagh forest reserve, Ardal region, chaharmehal and Bakhtiari Province, Centarl Zagros forest, and southwest Iranian state (Figure 1). Chartagh Forest reserve located 100 kilometer of southeast Shahrekord city and 40 kilometer of south Ardal region. The forests are located between 2100 and 3100 m a.s.l. Mean annual precipitation is 530.15 mm, Mean annual temperature is 18.3º C, Type of climate is sub humid in the basis of Domarton formula (Jahanbazi gojani *et al*, 1998).

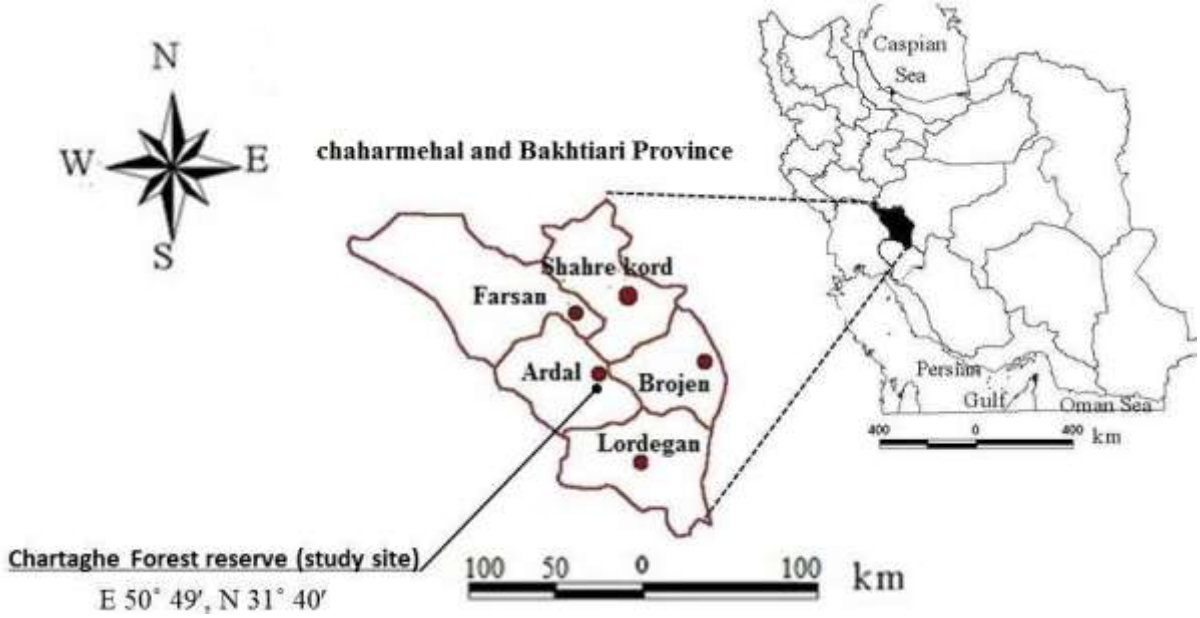

Figure 1: Study site location in the chaharmehal and Bakhtiari Province, Zagros region, and Western Iranian state of Iran.

Analysis

The aim of this study was investigation on the *Crataegus* sp spatial pattern in the central zagros forest. In this study 53 hectare of the study area was selected and perfect inventory. Information includes the position and kind of tree, height and two diameters of crown were recorded. Also methods for quantifying spatial pattern of trees based on indices or on statistical techniques have been compared but we focus on distance sampling techniques because of better results comparing to quadrat sampling. Distance methods were developed by plant ecologists to study vegetation communities (Ludwig and Reynolds, 1988). The use of sampling methods to estimate indices related to spatial pattern at reasonable accuracy levels often requires very large sample size and is not always feasible but neighbor sampling is generally more efficient than plot sampling (Kint *et al,* 2004). To study of spatial pattern used the quadrat sampling methods. Inventory method designed in the base of systematic-randomize methods by use the nearest individual, and inventory accrued in the five treatment and measured 5×32 (total 160)sample (measured the nearest individual).

Table 1: spatial pattern Indices used in this paper

	Ludwing &) Johnson & Zimmer (Reynolds, 1988	Pielou (Pielou, 1969)
Formula	$I = \left[(n+1)(\sum_{i=1}^{n}(r_{pi}{}^2)^2) \right] \Big/ \left[\sum_{i=1}^{n}(r_{pi}{}^2) \right]^2$	$P = \pi D \left(\frac{\sum_{i}^{N} X_i}{N} \right)^2$
characters	n=number of sample $=r_{pi}$ distance from nearest neighbor from sample point	$\sum_{i}^{N} X_i$ = Total of distance from nearest neighbor from sample point N=number of sample
Clumped	>۲	P>1
Uniform	I=2	P=1
Random	2>	P<1

RESULT AND DISCUSSION

Forest stand structure is a key element in understanding forest ecosystems. One of the major components of forest stand structure is the spatial arrangement of tree positions (Kint *et al*, 2004; Wolf, 2005). Studying the pattern of trees, can be used to better understand processes of forest structure (Nelson *et al*, 2002). Also quantitative assessment of the distribution of trees in a forest stand is an initial step towards understanding the forest community dynamics (Shimatani and Kubota, 2004). The quantity of Johnson & Zimmer and Pielou indexes in the five treatments showed in the table 2.

Table 2: The quantity of Johnson & Zimmer and Pielou indexes in the five treatments

	1	2	3	4	5	Spatial pattern
Johnson & Zimmer	3.14	2.08	3.26	2.33	2.09	clumped
Pielou	2.23	2.64	2.27	2.13	2.11	clumped

Spatial information for individual trees is increasingly sought by forest managers and modelers as a means to improve the spatial resolution and accuracy of forest models and management scenarios (Wulder *et al*, 2004). There are three main spatial patterns as following: clumped, random and dispersed (Wong and Lee, 2005; Wolf, 2005). Spatial pattern of trees can possibly indicate stand history, population dynamics, and species competition (Haase, 1995), and it may be able to explain what controls the co-existence and diversity of species in a forest (Batista and Maguire, 1998; Condit *et al*, 2000). Results showed that the quantity of Johnson & Zimmer and Pielou indexes indicated the clumped spatial pattern for *Crataegus* sp. Applied indicators showed a clumped pattern for chahartagh forest reserve (table 2). Safari *et al* (2010a), Safari *et al* (2010b), Heidari (2006) and Zabiholahii *et al*, 2012 showed a clumped pattern for oak forest and emphasis our results, but Haidari et al, 2013 reached the in the front in our study results because human utilization changed the spatial pattern of Blake forest. Overall results showed that the clumped pattern for *Crataegus* sp in chahartagh forest reserve in chaharmehal and Bakhtiari Province, Zagros region, and Western Iranian state of Iran.

CONCLUSION

Spatial pattern of trees can possibly indicate stand history, population dynamics, and species competition. all applied indicators showed a clumped pattern for *Crataegus* sp chahartagh forest reserve in Central Zagros region, and Western Iranian state of Iran.

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