Journal of Biodiversity and Environmental Sciences (JBES)
ISSN: 2220-6663 (Print) 2222-3045 (Online)
Vol. 3, No. 8, p. 49-57, 2013
http://www.innspub.net

RESEARCH PAPER OPEN ACCESS

The effect of destruction in positioning of *Quercus brantii* in Zagros forests, Iran (case study: Ghalehgol forest, Khoramabad City)

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Article published on August 24, 2013

Key words: Hundred percent inventory, positioning, *Quercus brantii*, Zagros forests.

Abstract

Knowledge of the positioning trees is useful In recognition of their mechanisms; describe ecosystem sustainability, design of appropriate management plans and protective and revival measures. Due to the *Quercus brantii* species recognize dominant species Zagros forests. In this research start with one hundred percent inventory of the range to 32 hectares positioning *Quercus brantii* trees studied in Ghalegol forests Khorramabad city. Then with taking cut trees (situation before destruction) positioning *Quercus brantii* trees re-examined and compared with the current situation in the region. For investigate trees positioning mentioned species was used from, Uniform angle and Pair correlation functions indices. Clark & Evans average results before and after destruction calculated 0.41 and 0.76. Represents change positioning from cluster to between random and cluster pattern. Uniform angle index average before and after its destruction (the current situation) calculated 0.52 and 0.45. Indicative random positioning *Quercus brantii* trees in both cases. Also pair correlation function indicated pair of *Quercus brantii* trees with distance between trees more than 5.1 m in the current situation have a random distribution. But this function is calculated by counting the species of trees (before destruction); random pattern indicated for the pair *Quercus brantii* trees the distance between trees 4.5 meters. Indices used in this research have high capacity compared and investigate positioning a species various stages or different species a stage and the results can be used for sustainable forest management.

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Introduction

Zagros mountains to the extend from Iran south to North West, due to the Rain clouds moisture source regions of western Mediterranean, has created conditions necessary for the establishment and expansion of forest cover. Zagros forests in recent years due to uncontrolled cutting and overgrazing are often ruined state and coppice form (Marvie mohajer, 2006). Zagros forests with an area of approximately 5 million hectares, has the largest forest habitats Iran (Jaziree and ebrahimi, 2003). The dominant species it's *Quercus brantii* and along with other species oak make up the dominant feature this forests and for this reason, also known is West Oak Forest (Marvie mohajer, 2006). *Quercus brantii* has habitats widest among species of oak growing in the Zagros basin (Jaziree and ebrahimi, 2003). These species in parts of central, southern and south-eastern Zagros constitute net society and almost 3.5 million hectares from 5 million hectare Zagros forests constitute this society. Unfortunately because perch this species and habitats In a context of socio - economic commodity (largely dependent on public forest lands) and under the influence the pressure of such uncontrolled cutting, grazing, etc. have been ruined state it was the most endangered plant communities in these areas and makes it difficult to achieve sustainable development (Marvie mohajer, 2006).

Spatial distribution of plants one from important aspect of plant ecology awareness is considered of the basics and necessities of each zone vegetation (Dale, 1998; Ludwing and Reynolds, 1998; Jayaraman, 1999). Spatial information about the structure and composition of forest plants in the broad scale is needed for management of forests and ecological research. Knowledge of the spatial distribution pattern forest stands can improve our understanding of ecological processes Such as mass deployment, growth, competition, production and mortality (Legendra and Fortin, 1989). Trees positions in the forest have profound impact on their survival in environments with a variety of conditions. Also various aspects trees spatial arises of this process, reflects the success of tree species at different stages of competition within and between species sequence (Getzin *et al.*, 2006; Law *et al.*, 2009). Recognition different patterns the main is in evaluation of ecology performance

a forest stand (Han *et al.*, 2008). The positioning trees, representing their distribution, as own from cluster, random, regular patterns or follow state between they (Pommerening, 2006). This pattern could be the caused by ecological conditions and also will change interventions forest stands management such as uniform pattern of natural mixed forests and stands of random patterns (wang *et al.* 2009). The positioning trees can outcome of environmental heterogeneity, natural and human disturbances, is subject to change competition within and between species and their life is over (Law *et al.* 2009). In general, for determine the positioning trees is used two original approaches data hundred percent and sampling. The best way to determine the positioning of data is hundred percent the stand of trees (Erfanifard and Mahdian, 2012). Positioning stands is measured by measuring and trees positioning determination and enter their analytical frameworks (Wang *et al.* 2009).

Today, in order to simplify the evaluation and measurement positioning and species diversity trees Indices have been developed measure than other indices, it is much easier (Motz *et al*, 2010). Sometimes use from a set of nearest neighbor indicators to determine the Positioning. It indices developed for the first time in 1992 by the institute of forest management, university of Göttingen, Germany, with Molecules having similar chemical structure of each tree are neighbors.

Scheoeder (2002) examined positioning Forests cover Canada Onsario state after the destruction and fires and arrived to the conclusion that the soil conditions and the type and destruction time has a crucial role in determining the positioning. Neef *et al* (2005) in a study conducted in the Amazon forests arrived to this conclusion big trees Positioning is the uniform. Chao *et al* (2007) according to studies conducted in the rain forest of southern Taiwan Concluded positioning 88.5% of species have cluster patterns and 9.1% have random patterns. In other research Zenner and Peck (2009) regularly recognized trees positioning in American forests. Recognition trees positioning in forest stands can understand the relationship between species, adopt practices silviculture, selection Inventory method and population dynamics models may help improve.

The aim of this research is study effect demolition on positioning *Quercus brantii* trees in Ghalegol forests, Kermanshah province, Middle Zagros forest.

Materials and methods

The study area

These study done in Ghalegol forests of Khoramabad (part of Zagros forests, Iran) which has an area of 9491 hectares located in 35 km southwest of the city (figure 2). The total area was selected for hundred percent inventories for the study 32 hectares. According to weather station Khorramabad, Average annual rainfall in the region is 725.24 mm. The topography of the area has plenty of ups and downs with most of the southern slope, Minimum and maximum altitude respectively of 1500m and 2500m. The region trees are mostly single storey and habitat coppice (Nuroaldini *et al.*, 2012).

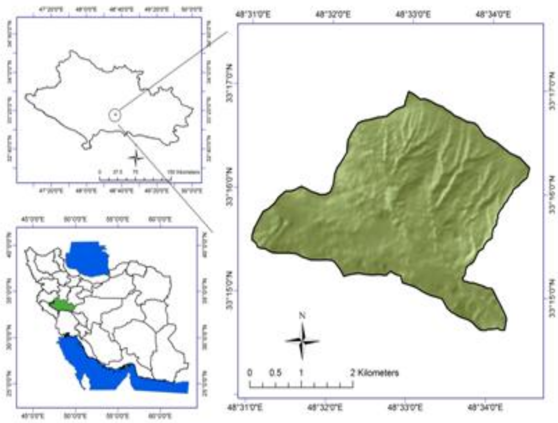

Fig. 1. Local perk allotments Ghalegol region in city of Khorramabad.

Collect the required information

To gather information needed for this research, after numerous trips and forest recognition state Ghalegol forests, the range of 32 ha was selected as representative of the forest area. Then, according to the study objectives and the indices Inventory to be made of hundred percent and due to the targets and indices characteristics such as species type, large and small canopy diameter and also azimuth and distance trees were determined relative to a point. In order to investigate trees positioning before its destruction compared with current conditions, Cut trees in the inventory area specifies and was recorded the information that. Then, to calculate all the indicators used in this study from crancod 1.3 Software (Pommerening, 2006a). This software is designed to analyze and evaluate the structural indices and great ability to of hundred percent inventory information and also circular and rectangular plots.

Applicated indices

In this research for investigate *Quercus brantii* trees positioning before and after its destruction used from Clark and Evans, Uniform angle and Pair correlation function indices. Also in other to investigate distances between trees used from Distance to neighbors indices.

Clark and evans index (CE)

To determine the variation of a forest stand have from Poisson forest (forest with distributed random), use from Clark and Evans index. In this index, with Using equation (1) distance average between a tree and its nearest neighbor (r_A) with expected mean (r_E), if the trees positioning are randomly distributed, compared.

Equation 1:

$$CE = \frac{r_A}{r_E} = \frac{\frac{1}{N}\sum_{i=1}^{N} r_i}{0.5 \times \sqrt{\frac{A}{N}} + 0.0514 \times \frac{P}{N} + 0.041 \times \frac{P}{N^{3/2}}}$$

Above equation is, ri: distance between tree i and its nearest neighbor (m), N: total number of trees within the plot, A: surface samples of square meter and P: Environment samples meter. When trees distribution in stand follow random pattern, amount CE is equal to 1. While CE less than 1 indicates cluster pattern and CE More than 1 indicates random pattern trees (Kint *et al*, 2000).

Uniform angle index (Wi)

This index is based on the nearest neighbor method investigate degree of regularity of the trees positioning in the country. Even structural group includes a reference tree and several of its neighbors. This index is based on comparing the angle between neighboring trees (α_j) relative to the standard angle (α_0). Amount standard angle (α_0) and Uniform angle index (Wi) is calculated from equation 2 and 3.

Equation 2:

$$\alpha_0 = \frac{360}{\text{number of neighbour} + 1}$$

Equation3:

$$W_i = \frac{1}{3}\sum_{j=1}^{3} v_{ij} \qquad v_{ij} = \begin{bmatrix} 1 \rightarrow & \alpha_j < \alpha_0 \\ 0 \rightarrow & \alpha_j \geq \alpha_0 \end{bmatrix}$$

In other to equation 3 amount Uniform angle index when using three neighboring trees,is one from four value zero, 0.33, 0.67 and 1. With The mean values of the mean accumulated ($\overline{W}_i$) calculate for total stand. low value $\overline{W}_i$ regular pattern reflects the high value that represents the cluster pattern trees (Corral *et al*, 2010).

Pair correlation function index (g(r))

This function depends on the distance between trees and unlike top indices result of this function is not a number, but is presented a chart form. Figure 2 represents the different state of the function at the investigate positioning trees.

Amount this index is calculate from Equation 4.

Equation 4:

$$P(r) = \lambda^2 \times g(r) \times df_1 \times df_2$$

In that P(r) probability of finding a tree in two imaginary circle C1 and C2 with Very small area df1 and df2, λ: is density of forest and g(r): pair correlation function. Investigate a forest trees with random positions, Pair correlation function chart parallel to the horizontal axis (distance between trees (m)), and is equal to 1. In situations where trees have a tendency to be regulation (such as: stands very old with distances between trees high) values g(r) in least distances between trees equal zero and if positioning a stand have cluster pattern amount this function in small distances between trees is more than one (Pommerening, 2002).

Distance to neighbors index

Also in other to investigate density of trees in the study area before destruction and comparison with current conditions, used from distance to neighbors index. Amount it's from distance average ever tree to its nearest neighbor calculate with use from Equation 5.

Equation 5:

$$D_i = \frac{1}{n} \times \sum_{i=1}^{n} S_{ij}$$

The above equation S_{ij} is equal to the distance between the reference tree i to neighboring j.

Results

In other to investigate density *Quercus brantii* trees in study area before destruction, and compare them with current conditions (after destruction), used from distance to neighbors index. Amount this index Come in both area in table 2. Also other quantitative information is observed *Quercus brantii* species before and after the destruction in table 2.

Average Clark and Evans index for *Quercus brantii* trees before and after destruction (current situation) calculated 0.41 and 0.76. Value of this index indicative cluster pattern *Quercus brantii* trees before destruction and state between cluster and is random for this trees in current situation (after destruction). Also average amount Uniform angle index for *Quercus brantii* trees in stage before destruction and after its calculated 0.52 and 0.54. Indicative random pattern *Quercus brantii* trees in ever two situation case study. Although average amount Uniform angle index for investigate stand structure is very useful, but however in order to better interpretation positioning used from distribution chart values this index in categories different (Figure 3).

Table 1. Quantitative information *Quercus brantii* species in Ghalegol forests in two different stages.

Stages different	Number of hectare	Average distance from each other (m)	Percent Crown canopy	Frequency (%)Species
Before destruction	181.87	6.13	54.26	97.4
After destruction	160.51	6.57	47.87	95.2

Unlike previous indices, Pair correlation functions with create a chart to investigate trees positioning (Figure 4). In other to compare the different stages plotted of their graphs and visible in figure 4. Visible in figure graph before the destruction cut number 1 vertical axis at a distance of 4.5 meter and in after stage destruction number 1 in at distance 5.1 and amount this function Distance between trees 4.5 meter for stage before destruction more than one. Means pair number *Quercus brantii* trees distance between them is less than 4.5 meter is more from expected modes in random distribution and indicate cluster pattern trees. But for after stage distribution number pair trees species mentioned distance between them is less than 5.1 meters, have cluster pattern.

Discussion and conclusions

The present forest structure is result complex relationship between trees with history different and combined with influence factors such as habitats, climate and disturbance (human interference, fires, pests and diseases, etc.). Analysis positioning trees with sizes and Competition conditions different at different stages can be useful in interpreting the evolutionary process current distribution pattern of trees. According to *Quercus brantii* have one of the largest habitats in the species oak vegetative of Zagros and this species resistance against unfavorable environmental conditions and have significant role in soil and water conservation and wildlife habitat. but unfortunately, due to human intervention in order to grazing, uncontrolled cutting and agricultural activities in Zagros forest destroyed many of these species trees completely. According to awareness from positioning trees efficient in understanding and solving ecological problems and propose solutions management, tried in this research in addition to effect of destruction on *Quercus brantii* trees as major species Zagros forests, also studied ability indices and functions used in this research at determination positioning trees.

In this research in other to investigate density *Quercus brantii* trees in both before destruction and after destruction used from distance average *Quercus brantii* trees nearest neighbor like theirs. With use from average can be easily different stands density and or density of species trees in an area in different stages determined and compared with each other.

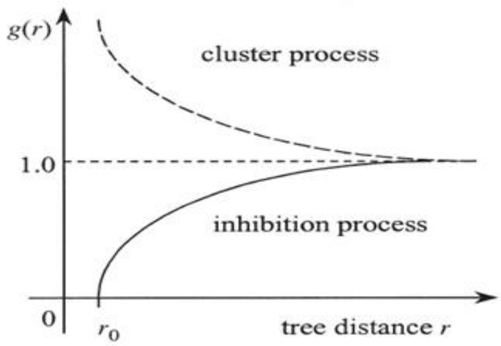

Fig. 2. Different modes pair correlation function chart (Pommerening, 2002).

Results obtained from Clark and Evans index for *Quercus brantii* trees in study area in current status (after destruction) showed between random and cluster pattern. But considering cuted *Quercus brantii* trees in range (before destruction) changed to cluster pattern. Benefits Clark and Evans index can point easily calculated and limited average results its (0-2.149). Therefore application this index simply enables when compared (Alijani, 2011). Noteworthy point about with this index, low reliability it's in when is investigated stands with cluster distribution (Kint *et al,* 2000). A result obtained from index is similar with results research Kunstler *et al* (2004) and Mouro *et al* (2007) different species pattern oak introduced cluster. positioning trees depends on various factors. Positioning species through seed to resurgence is in connection with the distribution pattern of seed (Calvino-Cancela, 2002). Due to the heavy seed *Quercus brantii* and seed fall trees under the weight of their, there are expect cluster pattern. For species their breeding done more by asexual methods such as coppice (shoot) and sucker, deployed patterns is more amount influenced initial pattern (Moeur *et al.* 1993). Also graz (2004) emphasized effect of tree regeneration on them positioning. Fangliang *et al* (1997) concluded with ecosystem development, populations positioning changed from cluster to random, In other words with increasing age trees and reach maturity, reduced competition between adjacent bases and trees indicate random pattern. Also Moravie and Robert (2003) pointed important role intraspecific competition as crucial factor in determination spatial pattern of population. But based on studies and observations in forest area case study The important reason change positioning trees from cluster to between random and cluster uncontrolled harvesting *Quercus brantii* trees as fuel, use fruit by indigenous people and overgrazing livestock in this region. This subject cause open spaces and empty and positioning trees were conversion state between random and cluster. Kint *et al* (2000) expressed in addition resulting changes natural processes; management and intervention were in stands also positioning change.

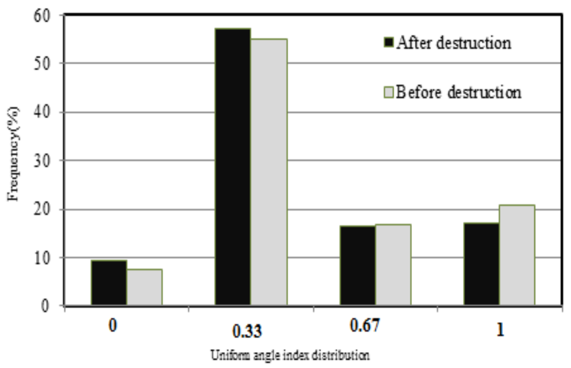

Fig. 3. Distribution of values Uniform angle index *Quercus brantii* species in two stages before destruction and after it's.

Uniform angle index indicate random pattern for *Quercus brantii* trees in ever two before and after destruction reason natural forests. This index also has high accuracy, so that research Hui *et al* (2007) expressed Uniform angle index than other positioning indices have higher ability. Pair correlation functions the supplement previous indices, offers useful information tree distribution. This function express number pair *Quercus brantii* trees in distance less than 5.1 m relative to each other are in stage after destruction, have cluster pattern. But renewed calculation this functions numeration cut trees(stage before destruction) indicate pair *Quercus brantii* trees are in distance of less than 4.5 meters of each other have cluster pattern. Cutting trees and reduction density it's in area cause increase function amount in current conditions (stage after destruction).

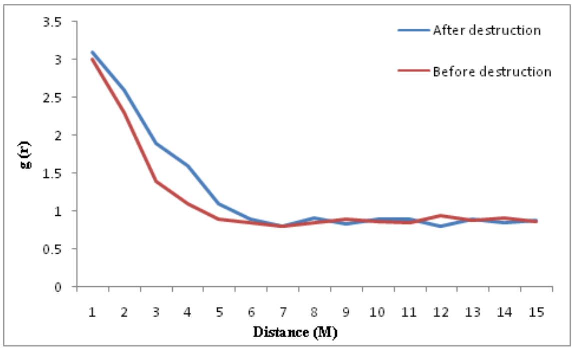

Fig. 4. Chart pair correlation functions *Quercus brantii* trees in stages before destruction and after it's (the current situation).

Understanding positioning different species is important in recognition the behavior and dynamics of ecological forest. Based on results observed indices and function used in describe the current situation positioning *Quercus brantii* trees and compare it with past positioning this species have high ability. These indices due to having benefits such as easily measured, low cost and high accuracy are superior to other methods (Pommerening, 2002; Aguirre *et al.*, 2003; Kint *et al.* 2003; Pommerening, 2006). With using from this indices, can assessed effective intervention and management on positioning forest species and with use from obtained results payments proper management of forest species in order to protect their.

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