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Research article/Araştırma makalesi

The survey of regeneration diversity in managed and unmanaged beech stands of north forests of Iran

Mir Mozaffar FALLAHCHAI [*1]

[1] Department of Forestry, Lahijan Branch, Islamic Azad University, Lahijan, Iran

Abstract

In this study regeneration diversity from the aspects of evenness and richness were compared and examined in the managed and unmanaged Nave-Asalem forests in north of Iran. In order to perform this survey, two parcels - managed and unmanaged ones- were chosen for the reason that they had identical species and physiography. A random-systematic inventory was done with a 100 m× 100 m inventory network and 7R (700 m) sample pieces. For analyzing the data, different indexes of tree species regeneration in each sample piece was computed, and for the examination of considerable difference, the differences among the indexes means were used in two parts of the t-test. The results revealed that among the diversity mean of Shannon-wiener, N Hiill and N Mc-Arthur indexes in managed and unmanaged stands a considerable difference in a 5% level exists. Also among Brillouins's diversity index mean in two stands was a considerable difference in the levels of 1% and 5%. In this case the most increases were observed in N Hiill index with the amount of 1.973 and N Mc-Arthur index with the amount of 2.127 in the managed stand.

Key words: diversity, regeneration, beech, richness, evenness

1. Introduction

Biodiversity is essential for human's life continuation, economical issues, ecosystems resistance and function (Singh, 2002). So species diversity index is one of the most important bio diversity indexes that is used in evaluating the habitations and its quantity depends on the stability of its environment. A great biodiversity confirms that since there's a favorable environmental condition numerous species can settle in that area (Ardakani, 2004). In area that has been influenced by human intervention for along period, the transformed forest structure is considered as a biodiversity essential threatening factor (Battles et. al., 2001).

The forest management quality and method is also a kind of human intervention which will have a great influence on species diversity, competition, stand structure and forest ecosystem's functions (Nagaik et. al., 2005). Up to now a lot of studies have been done about biodiversity but studies about the comparison of tree species diversity regeneration in managed and unmanaged areas are just a few. For example; In a research have studied the wooden plants species diversity from the view point of diversity indexes in some parts of the managed and unmanaged areas of Arasbaran forests in Iran and have concluded that the indexes of richness, evenness and species diversity in the stands of the managed forest areas compares to the unmanaged areas have a great difference (Alijanpour et. al., 2004). Also studied and compared the estimation methods of forest tree biodiversity indexes in Neka-Zalem Roud Forest management plan and concluded that the best index in calculating the heterogeneousness in parcelle level is Shannon-wiener index and in calculating evenness the best index is Nee's modified index (Dastanghou, 2004). Pour Reza's (2004) studies in Darbandam located in Kermanshah province related to the forest quantitative situation in the managed and unmanaged areas reveals that generally the stand's qualitative and quantitative conditions are better in the managed area compared to the unmanaged area. Qomi Ovili et. al. (2006) evaluated the quantitative characteristics in the two managed plant communities in Noshahr's Khairoud Kenar forest, The results of this study revealed that in the Fagetum community during different periods, remarkable differences haven't been made in the quantitative characteristics, while in Fageto- carpinetum community these changes have been considerable. Fallahchai and Marvie Mohadjer (2005) study in Siyahkal forests in north of Iran, also show that as the height from sea level increases the amount of species (species richness) decreases but the species frequency (Evenness) increases, and the most species diversity is found in 100 to 700 meters above the sea level and the least species diversity is found in 700 meters altitude above. In another research

* *Corresponding author* / Haberleşmeden sorumlu yazar: Tel.: +00981342222602; Fax.: +0098142222602; E-mail: mir_ mozaffar@ yahoo.com
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the influence of different forest management systems on plants species diversity in the central parts of Japan's Fagetum forests was studied (Nagaik et. al., 2005).

The results of this research showed that difference that was found in the species compositions among the primary forests and exploited forest isn't very considerable by shelter-wood method, while among the primary and afforestation forests and secondary forests has been a remarkable difference this is due to the dominance of regeneration trees renewal. Also in India, Parthasarathy (1999) studied the tree diversity in the ever green forest inter vented and non intervened sits. The results showed that species diversity, species type, species richness and their abundance is referred to human interference. In this way another study considered the plant diversity and general structures and concluded that there is a greater evenness in natural stands compared to the intervened ones. Also the flora species compounds, the covering percentage of each species and Simpson diversity index are appropriate indexes in order to assume the under study area's heterogeneousness. Rodringuez et. al. (2004) studied forest biodiversity indexes in the area of Anders in Colombia.

The output of the study showed that factor of being above the sea level and geomorphologic differences are some of the most important factors in causing biodiversity. And population density and economical activities are introduced as the negative elements for biodiversity. Thus management based on protection can be a suitable technique for preserving the forest species diversity. So the aim of this research is to consider and compare the tree species regeneration of forest stands in the managed and unmanaged areas with a resembling physiographic and species compounds.

2. Materials and methods

2.1. The under study area

One of the most abundant and economically important hardwood genera in northern hemisphere temperate forests is *Fagus* (Ertekin et. al., 2015). This study has been carried in Asalem Forests. Asalem forests are located in north of Iran in 37º, 38´ northen latitude and 48º, 52´ eastern longitude and its 800 meters above the sea level. The accomplishment locality of this study is the first series forests of Nave-Asalem that belongs to the seven Nove Anjiz district (figure 1) in which since 1969 the management plan has began in it. Generally this set is divided in to 48 parcelles and since the beginning its 23rd parcelle was managed as the testifier parcelle and up to now no intervention has taken place in it. The recent study is carried out in parcelle 23 (as the managed parcelle) and 12 (as the unmanaged parcelle). These tow parcelles are placed beside each other and many of their regional, edaphic, physiological characteristics are identical. Geologically they belong to the second geological era, and pedagogically the soil type is attritive humus and their mother rock is slate clay. The average annual rain in the project area is about 945 millimeters and the average annual heat temperature is 12.4 degree centigrade and the regions climate according to (Emberge) method is chilly humid.

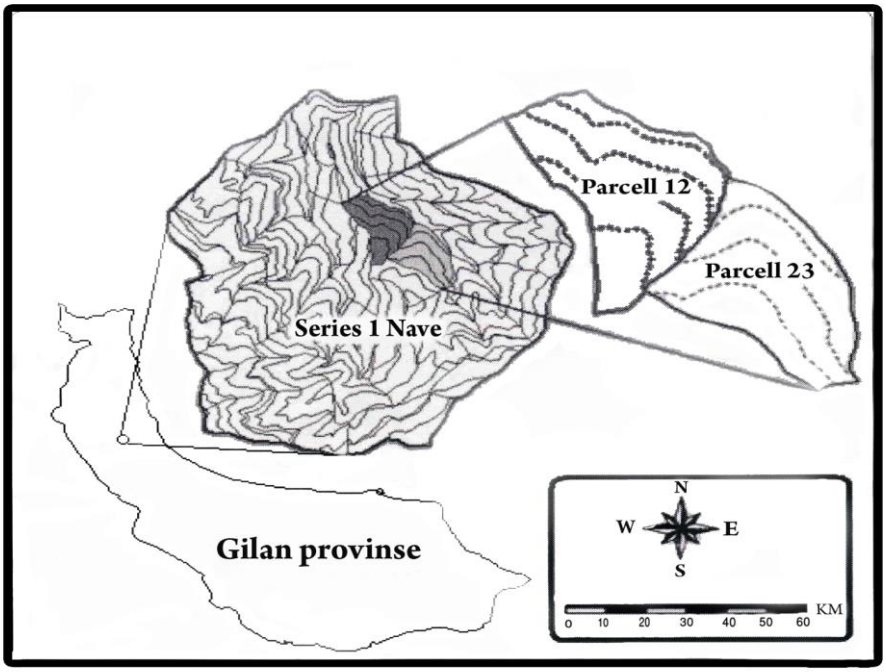

Figure 1. The under study area position in Guilan province

2.2. Inventory method

For this research parcelle 12 (unmanaged) with a 63 hectares measurement and parcelle 23 (managed) with a 43 hectares measurement were selected in Nave-Asalem series 1. Since in this area the stand form was harmonious and homogenous and carrying out the sample pieces was convenient and accurate the random – systematic sampling was used. The sample piece measurement was considered 7Rs (700 m) so that the tree inventory error placed on the sample piece border would be minimized. Generally 75 sample pieces (disconnectedly 32 sample pieces in the managed area and 43 sample pieces in the unmanaged area) were carried out in the area with the 100 × 100 network inventory and by noticing this case in this study the inventory intenseness was calculated as 5.2 percent.

2.3. Species diversity Indexes

Species diversity is a function of richness (number of species) and also the Evenness (Krebs, 1989). For the purpose of assuming species diversity, several indexes are available and in this research the most common ones are used in order to account the sample pieces species diversity.

Simpson Index (1949);
This index formula is as follows (Krebs, 1989)

$$1-D=1-\sum_{i=1}^{s}\left[\frac{ni(ni-1)}{N(N-1)}\right]$$

In this 1-D is Simpson diversity index formula, s is the species quantity (richness), n_i; is the abundance of i species and N is the abundance of all species. This index has a greater sensitivity towards the general covering species in the community and its amplitude changes is between 0 to $1-\frac{1}{S}$.

N_2 Hiill (1973);

Hiill by means of Simpson index (Krebs, 1989) introduced the following formula which specifies species quantity with more frequency.

$$N_2=\frac{1}{D}=\frac{1}{\sum_{i=1}^{s}p_i^2}$$

In this formula, N_2 is the number of species in great supply, p^i consanguineous abundance of i species, and amplitude changes of N_2 is one to S (species quantity).

Shannon-Wiener Index (1949);

This index has a greater sensitivity to rare species in the community and its formula is as follows (Krebs, 1989).

$$H'=-\sum_{i=1}^{s}p_i\log_2 p_i$$

In which H' is Shannon-wiener's function, s and p^i in sequence are species quantity and consanguineous abundance of i species.

The amount of H' changes is among $\log[N/(N-s)]$ to $\log_s$ in which Mc-Arthur in 1965 by the means of Shannon-wiener function and through another formula calculated the number of the abundant species that is as follow (Krebs, 1989).

$$N_1=2^{H'}$$

In this formula N_1 is the number of abundant species and H' is the Shannon-wiener's function.

Brillouins Index;

As Shannon-wiener function this index is sensitive to the rare species abundance in the community or sample and its formula is as follows (Krebs, 1989).

$$H = \frac{1}{N}\log\left[\frac{N!}{n_1!n_2!n_3!.....}\right]$$

In which H is Shannon-wiener's index, N the abundance of all species and n_1, n_2, n_3,… is related to the abundance of different species.

2.4. Statistical analysis

For the purpose of the data related to species diversity indexes Ecological Methodology Software was used in two areas and the remarkable difference between the means of the indexes was accounted by the t statistical test (Bihamta and Zareh, 2008) by the use of SPSS software.

3. Results

Comparing the diversity indexes regarding to tree species regeneration in the managed and unmanaged areas reveals that the amount of all indexes in the managed areas is more than unmanaged areas and these differences are more obvious in Shannon-wiener index, N_2 Hiill and Mc Arthur (table 1).

Table 1. the results of tree species regeneration diversity index in managed and unmanaged areas

Feature	**Managed area**			**Unmanaged area**		
Diversity index	**mean**	**Standard of deviation**	**Standard of error**	**mean**	**Standard of deviation**	**Standard of error**
Simpson Index	0.574	0.191	0.034	0.449	0.279	0.042
Shannon-Wiener	1.077	0.420	0.074	0.788	0.509	0.077
N_2 **Hiill**	1.973	0.699	0.123	1.506	0.930	0.141
Brillouins	0.774	0.326	0.058	0.531	0.361	0.055
N_1 **MC Arthur**	2.127	0.732	0.129	1.597	0.974	0.148

Figurers 2 to 6 also show the mean and the Confidence limits of tree species regeneration diversity indexes in the managed and unmanaged areas. As seen except Simpson diversity index the other diversity indexes after 40 years managed management accomplishment and stand exploitation have a considerable difference with each other and considerably unmanaged areas wooden species regeneration diversity. Sapling and thicket have decreased in germination stage and in this case N_2 Hiill index with the amount of 1.973 and MC Arthur index with the amount of 2.127 have had the greatest increase in the managed stand.

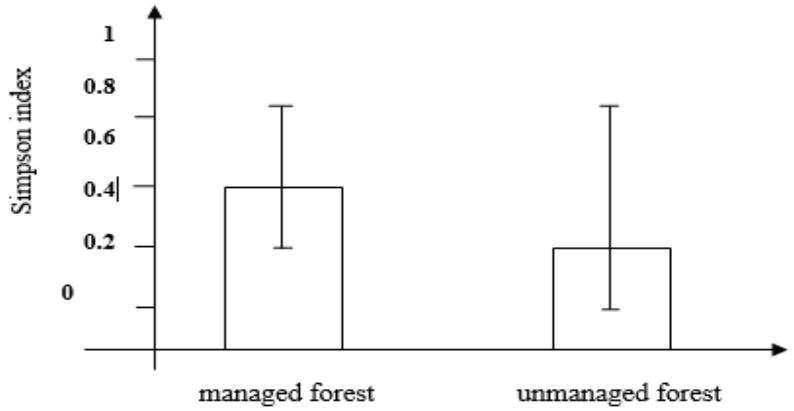

Figure 2. The mean and confidence limits of Simpsons diversity index managed and unmanaged stands

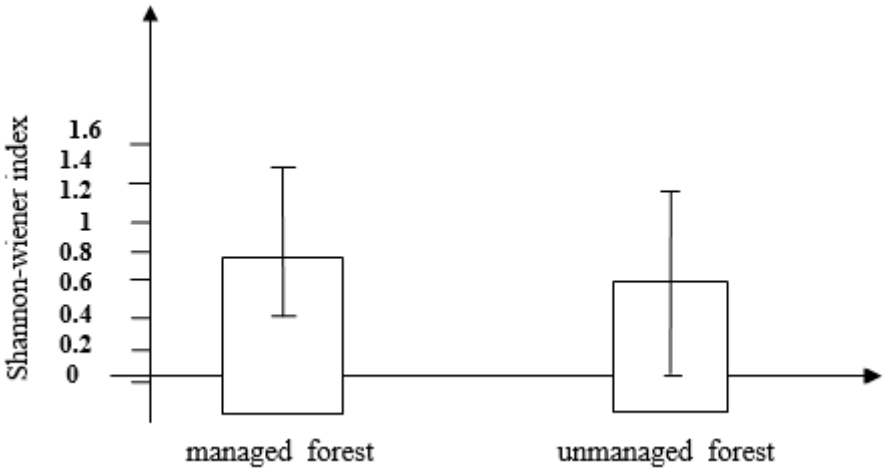

Figure 3.The mean and confidence limits of Shannon-Weiner's diversity index in managed and unmanaged stands

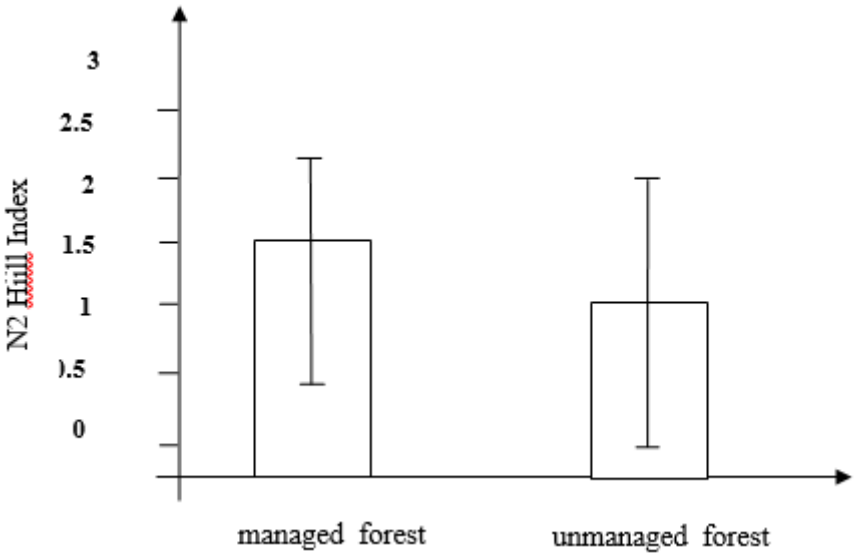

Figure 4. The mean and confidence limits of Hiill's diversity Index in managed and unmanaged stands

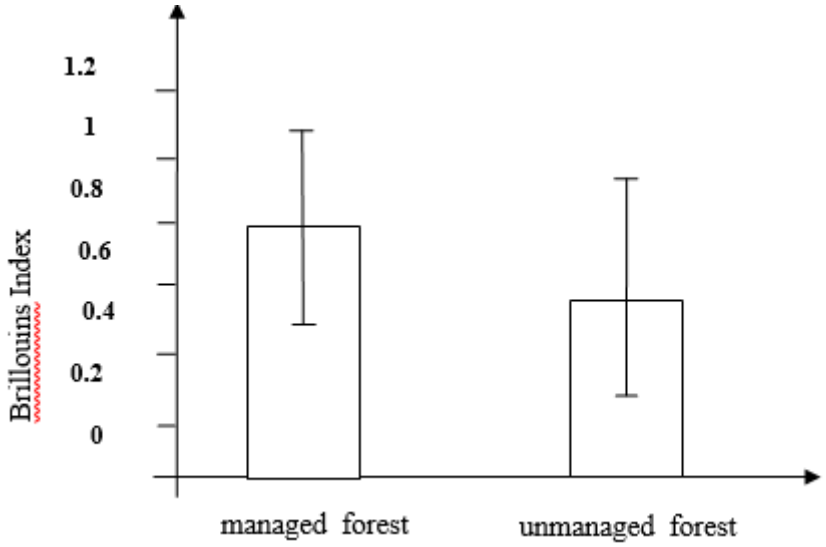

Figure 5. The mean and confidence limits of Brillouins diversity index in managed and unmanaged stands

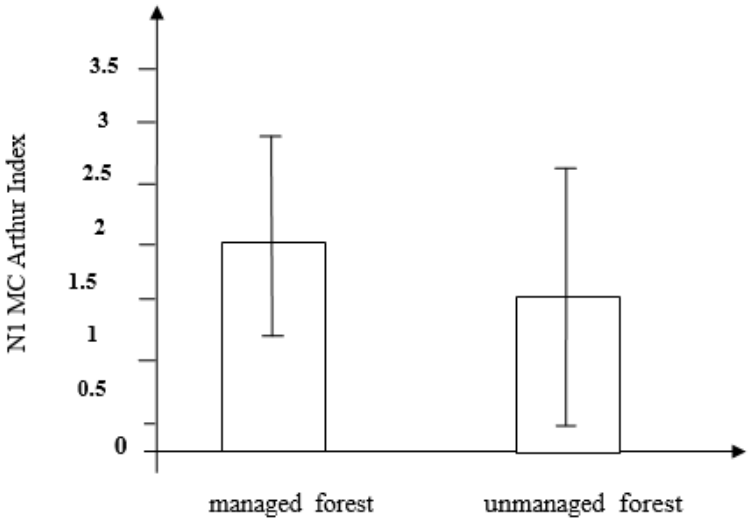

Figure 6. The mean and the confidence limits of MC Arthur's diversity Index in managed and unmanaged stands

In order to compare the tree species regeneration diversity means of different indexes the analysis result of managed and unmanaged areas are presented in table 2. Among Shannon-wiener diversity index, N_2 Hiill and N_1 MC Arthur as noticed within the two stands is a considerable difference in a 5% level. Also among Brillouins diversity index mean within the two stands a considerable difference in 1 and 5% level is noticed. But among Simpson's diversity index no considerable difference has been noticed within the two stands in 1 and 5 percent level.

Table 2. The comparison of tree species regeneration diversity indexes in managed and unmanaged areas by t examination

Feature	Managed area	Unmanaged area	t
Simpson Index mean	0.574	0.449	1.71^{ns}
Shannon-wiener Index mean	1.077	0.788	2.61^{*}
N_2 **Hiill Index mean**	1.973	1.506	2.38^{*}
Brillouins Index mean	0.774	0.531	2.997^{**}
N_1 **MC Arthur Index mean**	2.127	1.597	2.57^{*}

ns = non-significant * = it is significant at 0.05 level ** = it is significant at 0.01 level

4. Conclusions and discussion

From tree species regeneration biodiversity point of view in the stage of sapling and thicket, the species diversity volume according to N_2 Hiill index, Shannon-wiener, Brillouins and N_1 MC Arthur within the two managed and unmanaged stands is a great difference, and in all cases the diversity index within the two managed stands have greater amounts compared to the unmanaged stand. In Qomi Ovili's (2006) studies regeneration diversity in Fageto-Carpinetum stand was more pure than Fagetum. In Alijanpour et. al. (2004) studies in Arasbaran region management based on protection lead to the growth of tree species regeneration diversity in the area. In the same case considering the regeneration diversity situation within the two stands indicates that management based on exploitation in the unmanaged area has decreased the regeneration accumulation in this stand. Smith (1996) tells the main reason of natural resource management is biodiversity protection and regeneration continuance, in Pour Reza's studies (2004) management based on protection has the stand's regeneration quantity. In this study the main reason for the decrease in the stand's regeneration accumulation was known as Fagetum stand's shade tolerant and over opening of the crown in exploited areas. In Tabari et. al. (2003) studies this reason has clearly been shown. In this course (Elliottand and swank, 1994; Schuler and Gillespie, 2000; Crow et. al., 2002; Brashears et. al., 2004) in their researches about exploitation's effect and result on regeneration accumulation and species element have obtained similar results. Thus unmanaged stands from the respect of many indexes have an undesirable condition compared to managed stands, and we can point out to the main factors as marking desirable and high quality trees in unmanaged stands, exploitation detriments, domesticated animals grazing and inaccurate management in these stands.

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