Evaluation structural diversity of *Carpinus betulus* stand in Golestan Province, North of Iran

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Abstract. Sohrabi V, Rahmani R, Jabbari S, Moayeri H. 2011. Evaluation structural diversity of *Carpinus betulus* type in Golestan province 30 modified Whittaker plots by systematic random system were located. Per plot the characteristic of trees and shrubs species (Species name, diameter and height of trees) are recorded. The heterogenity indices of Simpson, Shannon–Wiener, Simpson’s reciprocal and number of equally common species were used for the quantitative data. Toward better understand from diversity condition in horizontal and vertical composition of stand, the diameter divided in 10 cm classes and Method of Mohajer and the height divided in 10 m height classes and dominant height, then number of diversity of each class extracted by Ecological Methodology software V.7. The results showed with increase of diameter and height classes, decrease species diversity. Also regeneration layers diversity has significant difference with trees layers. Thus, the study of biodiversity changes in different diameter and height category cause ecologically precise perspective in management of forest stands.

Key words: structure diversity, indices diversity, diameter and height classes.

INTRODUCTION

Human knows the concept and the importance of biodiversity from earlier century. Plato frequently point out the diversity and believe that if there is more diversity in the world, the world will be better (Beasapour 2000, Ejtehadi et al. 2009). Today, the word of biodiversity applies by various science experts, such as ecologists. The convention of biodiversity of USA, describe biodiversity as: there is a difference in all the life type all sources such as marine, ground and ecological complex combination and include the diversity within species, between species and ecosystems (Markandya et al. 2008). One of the constant keys of management of uneven age forest is the true understanding about spatial structure of forest (Costanza et al. 2007). Forest structure is the important feature in management of forest ecosystems (Zenner and Hibbs 2000). Structural features are used to determine the species neech heterogeneous experiment and plant dynamic time, management of regeneration patterns and fragmentation dynamic, description of microclimate diversity and predicting the wood production (Youngblooda et al. 2004). Management of forest stands performs by stands structure control (age, size and tree density) and forest structure (size and spatial order of tree) because the concept of forest structure is more important than species combination (Oheimb et al. 2005). The study of natural forests structure defined the way of desired structure that the use of appropriate silviculture operation and stimulation of natural structure in under management stands considered as the way to keep the biological diversity and forest dynamic and stability (Markandya et al. 2003). The study of forest...
structure especially in virgin forests is very important and gives us comprehensive information about the condition in forest for programming. The diversity of a forest stand may not be sufficiently described by tree species diversity alone. Structural diversity, resulting from recruitment of trees of different sizes into multilayered canopies, should also be taken into account (Liang et al. 2007). This characteristic, which can be approximated by the diversity of tree size, affects the amount of light and precipitation received by subordinate trees and understory plants (Anderson et al. 1969), and may thus influence the productivity of forest ecosystems. Thus manipulating tree-size diversity is a practical tool for forest managers who strive for greater biodiversity and/or greater productivity (Varga et al. 2005).

Ahani et al (2006) do the research about species diversity of tree based on the diameter class in Acer sites in Shafarud forests. So, rhombus plots in half hectare study in forest according to Acer (34 plots). First the feature within each plot, its slope, aspect, height from sea level and then total diameter of trees up to more than 10 cm measured. Biodiversity accounted in four diameter classes (10-30, 35-50, 55-80, 80-120 cm). The result showed that the Shannon and N1 Mac Arthur indices in diameter class of 35-50 cm, have greatest amount, while the index of Simpson and N2 hill shows the greatest amount in diameter class of 10-30 cm. The purpose of this paper is the evaluation of structural diversity in diameter and height classes and their changing process with changing of diameter classes and height category in *Carpinus betulus* (Persian: Mamarz) type in Golestan province, IR Iran.

**MATERIALS AND METHODS**

**The regions of study**

Kohmian forestry plan is located in 98 wateshade domain which is limited in north is village of Kohmian, Fazel Abad, Khanduz Sadat and Marzbone, in south and west to Naeem s forestry plan and in east to vatan forestry plan. Its east longitude is 55-14-49 to 55-10-30 and its north width is 37-65-15 to 37-00-00 degrees (Figure 1).

![Figure 1. Map of the site study in in Golestan Province, North of Iran. 1. Shastkalateh, 2. Tavir, 3. Kohmian, 4. Takht, 5. Loveh, 6. Farsian.](image-url)
Table 1. Indices used in this paper (Ejtehadi et al. 2009)

<table>
<thead>
<tr>
<th>Equation</th>
<th>Index</th>
<th>Description of equation</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1-D = 1 - \sum (p_i)^2$</td>
<td>Simpson</td>
<td>(1-D) = Simpson’s index of diversity</td>
</tr>
<tr>
<td>$H' = \sum_i (p_i)(\log_2 p_i)$</td>
<td>Shannon–Wiener</td>
<td>$H'$ = information content of sample (bits/individual) = index of species diversity</td>
</tr>
<tr>
<td>$\frac{1}{D} = \frac{1}{\sum_i p_i^2}$</td>
<td>Simpson’s reciprocal</td>
<td>$1/D$ = Simpson’s reciprocal index (= Hill’s $N_2$)</td>
</tr>
<tr>
<td>$N'_e = e^{H'}$</td>
<td>Number of equally common species</td>
<td>$H'$ = information content of sample (bits/individual) = index of species diversity</td>
</tr>
</tbody>
</table>

Research method

This research is based on sampling by systematic random system and the center of plots in forest is determined. To study and investigation, 30 modified Whittaker plots in range of 850-950 m altitude from the sea level in north aspect were located. In this 20x50 meter frame, the characteristic of trees and shrubs species (species name, diameter and height of trees) are recorded. The heterogeneity indices of Simpson, Shannon–Wiener, Simpson’s reciprocal and number of equally common species and evenness indices of Simpson, Camargo, Smith-Wilson and modified nee were used for the quantitative data (Table 1). Then aforesaid characteristics saved as information bank in Excell 2010. Then indices account by Ecological Methodology software v.7.0 (Krebs 1999). Analyze of data was done by analyze of variance (ANOVA) and Duncan’s multiple range test (DMRT).

RESULTS AND DISCUSSION

Next of survey recorded number of 10 trees species dependent of 8 families and 3 shrubs species dependent of 2 families that show notable statistics (Table 2).

Table 2. Composition of trees and shrubs species.

<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Family</th>
<th>Trees/Shrubs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quercus castanefolia</td>
<td>Fagaceae</td>
<td>T</td>
</tr>
<tr>
<td>Carpinus betulus</td>
<td>Betulaceae</td>
<td>T</td>
</tr>
<tr>
<td>Parrotia persica</td>
<td>Hamamelidiaceae</td>
<td>T</td>
</tr>
<tr>
<td>Tilia beginda</td>
<td>Tiliaceae</td>
<td>T</td>
</tr>
<tr>
<td>Acer insigne</td>
<td>Aceraceae</td>
<td>T</td>
</tr>
<tr>
<td>Ulmus glabra</td>
<td>Ulmaceae</td>
<td>T</td>
</tr>
<tr>
<td>Acer cappadocicum</td>
<td>Aceraceae</td>
<td>T</td>
</tr>
<tr>
<td>Alnus glutinosa</td>
<td>Betulaceae</td>
<td>T</td>
</tr>
<tr>
<td>Crataegus monogyna</td>
<td>Rosaceae</td>
<td>S</td>
</tr>
<tr>
<td>Mespilus germanica</td>
<td>Rosaceae</td>
<td>S</td>
</tr>
<tr>
<td>Prunus avium</td>
<td>Rosaceae</td>
<td>S</td>
</tr>
<tr>
<td>Sorbus torminalis</td>
<td>Rosaceae</td>
<td>T</td>
</tr>
<tr>
<td>Diospyros lotus</td>
<td>Ebenaceae</td>
<td>S</td>
</tr>
</tbody>
</table>

Diversity indices in 10 cm diameter classes

The under study diversity indices in this paper shows the decrease in the diameter classes of 10cm with increase of classes. The most diversity number is in diameter class of 0-10 cm and the least diversity number is in diameter class of 90-100 cm. Other than Simpson diversity index that shows the least diversity number in diameter class of more than 100cm, the significant different is between diameter classes in 1% level (Figure 2).

Diversity indices in diameter classes by method of Mohajer

Diversity indices shows decrease process with the increase of diameter classes but it increase again in last class (dbh>80). The most diversity number is in the class of 0-10 cm and the least diversity number is in class of 60_80 cm. The diameter classes (20-30, 30-60, dbh>80) are not significant different. The significant different is between diameter classes in 1% level (Figure 3).

Diversity indices in 10m height classes

Diversity indices have orderly decrease process. The most diversity number is in height class of 0-10m and the least diversity number is in height class of 40-50m. The significant different is between height classes in 1% level (Figure 4).

Diversity indices in dominant height of height classes

The most diversity number in all indices is for $h<\frac{1}{3}h_{mn}$ class and the least diversity number is for $1/3h<h>2/3h_{mn}$ height class. Diversity indices, first, decrease then increase in third class. First height class has significant difference with other classes in level of 1% (Figure 5).

Discussion

Forest structure is the important feature in management of forest ecosystems (Zenner and Hibbs 2000). The study of natural forests structure defined the way of desired structure that the use of appropriate silviculture operation and stimulation of natural structure in under management stands considered as the way to keep the biological diversity and forest dynamic and stability (Markandya et al. 2003). Whereas, structure characterize the building (vertical and horizontal), composition and diversity of
Figure 2. The comparison of diversity indices in 10cm diameter classes. A. Simpson, B. Simpson’s reciprocal, C. Shannon–Wiener, D. Number of equally common species.

Figure 3. The comparison of diversity indices by method of Mohajer (2005). A. Simpson, B. Simpson’s reciprocal, C. Shannon–Wiener, D. Number of equally common species.

Figure 4. The comparison of diversity indices in 10m height classes. A. Simpson, B. Simpson’s reciprocal, C. Shannon–Wiener, D. Number of equally common species.

Figure 5. The comparison of diversity indices in height classes by dominant height. A. Simpson, B. Simpson’s reciprocal, C. Shannon–Wiener, D. Number of equally common species.

Forest stands. Forest stands have different structure in various sections (linear and phenomenal) like a building. For recognition, study and precise programming of forest stands, its features need to consider according to different sections. Various profiles (linear and phenomenal) could be dividing for forest stands. The study of forest stand profile especially in virgin forests is very important and gives us comprehensive information about structure of these forests (Mohajer 2005). For better understanding of the structure of forest stand, we analyzed it according to the vertical and horizontal structure. Species diversity of tree and shrub in this type have significant different in low diameter and height classes with up diameter and height classes classes. Diameter and height classes below of 10 cm, account as 10 regeneration layer, so diversity of regeneration layer is more than the diversity of tree layers (Pourbabaei et al. 2006; Sohrabi 2010). This is due to the decrease of canopy of small saplings and it need low light than higher age process in this classes. By the increase of diametrical and height classes, the diversity decrease. It is obvious that the structure diversity naturally in the virgin forest decrease depend on site condition and with increase of stand age and its move toward climax, because gradually increase of trees age dominant species dominant against the under species. Trees are the main elements in forest ecosystems that other living thing life of this ecosystem depends on the life of them. Therefore removing of the tree threatened the life of the existent in this ecosystem. The main role of forest engineer is the marketing of forest (Mohajer 2005). In this step choosing of trees perform by considering of target diameter from defined species and gradually the number of trees in defined diameter decreased and so the repeating act might remove some class of trees. It is threatened the structure diversity and the species diversity. Trees diversity in higher diametrical and altitudinal categories is part of the lower diametrical category diversity. Any changes in above level might change the ground cover. Tree dimension diversity has an effect on the amount of light and raining by small plant and trees (Anderson et al.1969). This has influence on the produce of forest ecosystems.
CONCLUSION

The increasing of diameter and height classes, decrease species diversity. Regeneration layers diversity has significant difference with trees layers. Thus, the study of biodiversity changes in different diameter and height category cause ecologically precise perspective in management of forest stands.

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REFERENCES


Sohrabi V. 2010. Comparing of species and structure diversity in gradient of between Shastkolateh Beech Forest and Loveh Oak Forest [M.Sc thesis]. Faculty Forestry, Gorgan University of Agriculture Sciences and Natural Resources. Gorgan, IR Iran.


