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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 stands in Golestan Province, Northern Iran. Nusantara Bioscience 3: 23-27.* In order to investigate 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 heterogeneity 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.

Keywords: structure diversity, indices diversity, diameter and height classes.

Abstrak. *Sohrabi V, Rahmani R, Jabbari S, Moayeri H. 2011. Evaluasi keragaman struktur tegakan Carpinus betulus di Provinsi Golestan, Iran bagian utara. Nusantara Bioscience 3: 23-27.* Dalam rangka untuk menyelidiki struktur keragaman tipe *Carpinus betulus* di provinsi Golestan, 30 plot Whittaker yang telah dimodifikasi dibuat secara sistem random sistematis. Pada setiap plot, karakteristik spesies pepohonan dan semak (nama spesies, diameter dan tinggi pohon) dicatat. Indeks heterogenitas dari beberapa macam indeks Simpson, Shannon-Wiener, Simpson's reciprocal dan jumlah spesies yang umum ditemukan digunakan untuk data kuantitatif. Untuk lebih memahami kondisi keanekaragaman dalam tegakan horizontal dan vertikal, maka dikelompokkan ke dalam diameter dalam kelas 10 cm, metode Mohajer, tinggi dalam kelas 10 m, dan ketinggian yang dominan, kemudian jumlah keragaman setiap kelas ditentukan dengan software Ecological Methodology v.7.0. Hasil penelitian menunjukkan bahwa peningkatan kelas diameter dan tinggi, menyebabkan penurunan keragaman spesies. Keragaman lapisan regenerasi memiliki perbedaan signifikan dengan lapisan pohon. Studi perubahan keanekaragaman hayati dengan kategori diameter dan tinggi yang berbeda memerlukan perspektif ekologis yang tepat dalam pengelolaan tegakan hutan.

Kata kunci: keanekaragaman struktur, indeks diversitas, kelas diameter dan tinggi.

INTRODUCTION

Human knows the concept and the importance of biodiversity from the earlier century. Plato frequently points 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 niche, 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 structures 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). Various study done about in forest structure.

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 Shanon 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 watershed domain which is limited in north is Village of Kohmian, Fazel Abad, Khanduz Sadat and Marzbone, in south and west to Naeems 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).

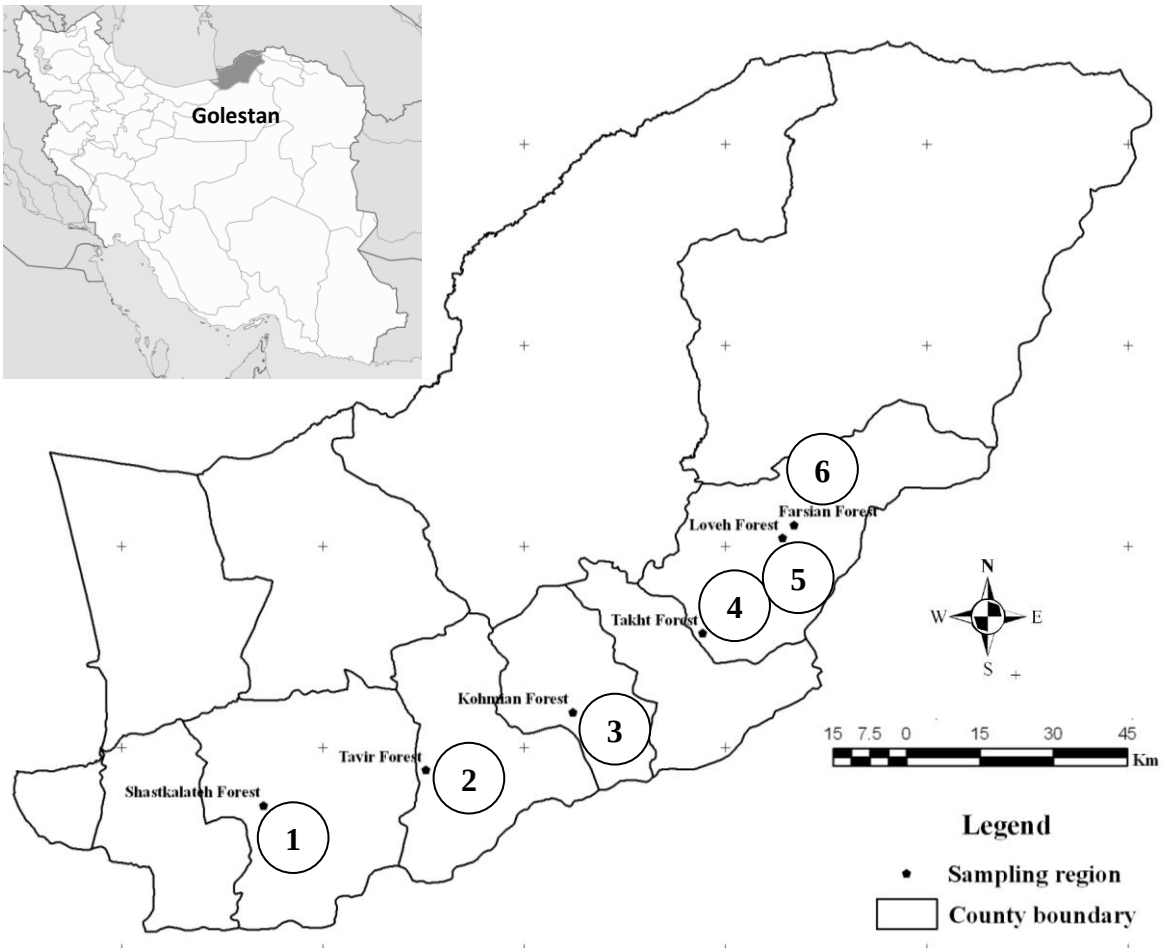

Figure 1. Map of the site study in Golestan Province, North of Iran. 1. Shastkalateh, 2. Tavir, 3. Kohmian, 4. Takht, 5. Loveh, 6. Farsian.

Table 1. Indices used in this paper (Ejtehadi et al. 2009)

Equation	Index	Description of equation
$1-D=1-\sum(p_i)^2$	Simpson	(1-*D*) = Simson's index of diversity p_1 = proportion of individual species *I* in the community
$H'=\sum_{i=1}^{s}(P_i)(Log_2^{Pi})$	Shannon–Wiener	*H'* = information content of sample (bits/individual) = index of species diversity *s* = number of species p_1 = proportion of total sample belonging to *i*-th species
$\frac{1}{D}=\frac{1}{\sum p_i^2}$	Simpson's reciprocal	1/*D* = Simson's reciprocal index (= Hill's N_2) p_1 = proportion of individual species *i* in the community
$N_1=e^{H'}$	Number of equally common species	*H'* = information content of sample (bits/individual) = index of species diversity *s* = number of species p_1 = proportion of total sample belonging to *i*-th species

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 afore said 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 on 8 families and 3 shrubs species dependent on 2 families that show notable statistics (Table 2).

Table 2. Composition of trees and shrubs species.

Scientific name	Family	Trees/Shrubs
Quercus castanefolia	Fagaceae	T
Carpinus betulus	Betulaceae	T
Parrotia persica	Hamameliadaceae	T
Tilia begunda	Tiliaceae	T
Acer insigne	Aceraceae	T
Ulmus glabra	Ulmaceae	T
Acer cappadocicum	Aceraceae	T
Alnus glutinosa	Betulaceae	T
Crataegus monogyna	Rosaceae	S
Mespilus germanica	Rosaceae	S
Prunus avium	Rosaceae	S
Sorbus torminalis	Rosaceae	T
Diospyros lotus	Ebenaceae	S

Diversity indices in 10 cm diameter classes

The understudy 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 the Simpson diversity index that shows the least diversity number in diameter class of more than 100cm, the significant difference is between diameter classes in 1% level (Figure 2).

Diversity indices in diameter classes by method of Mohajer

Diversity indices show decrease process with the increase of diameter classes but it increases 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 difference 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 difference 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 $h<1/3h_m$ class and the least diversity number is for $1/3h<h>2/3h_m$ 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 structures 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

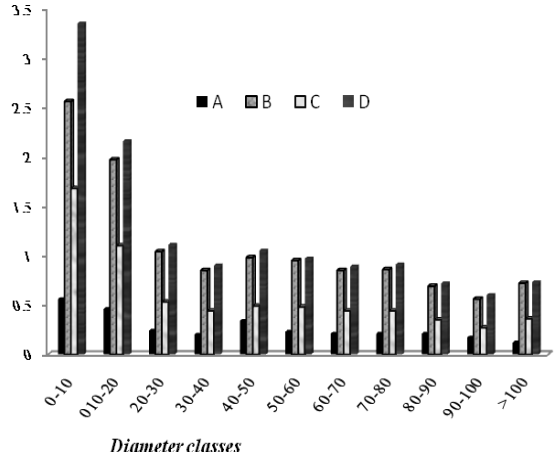

Figure 2. The comparison of diversity indices in 10cm diameter classes. A. Simpson, B. Simpson's reciprocal, C. Shannon–Wiener, D. Number of equally common species.

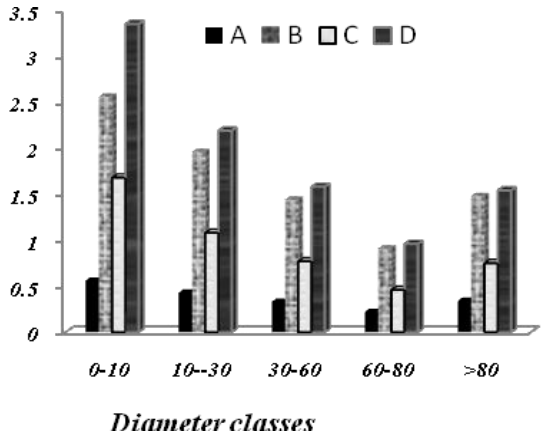

Figure 3. The comparison of diversity indices by method of Mohajer (2005). A. Simpson, B. Simpson's reciprocal, C. Shannon–Wiener, D. Number of equally common species.

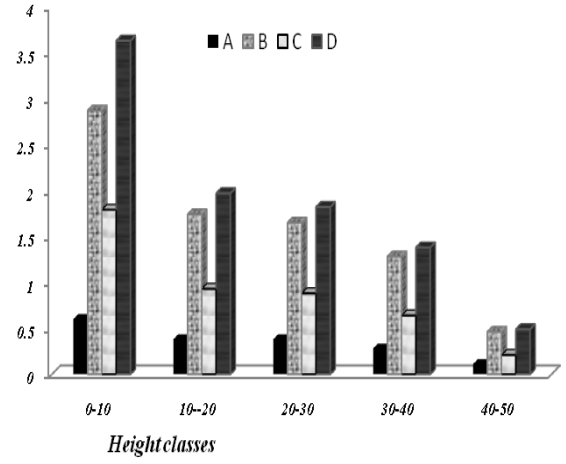

Figure 4. The comparison of diversity indices in 10m height classes. A. Simpson, B. Simpson's reciprocal, C. Shannon–Wiener, D. Number of equally common species

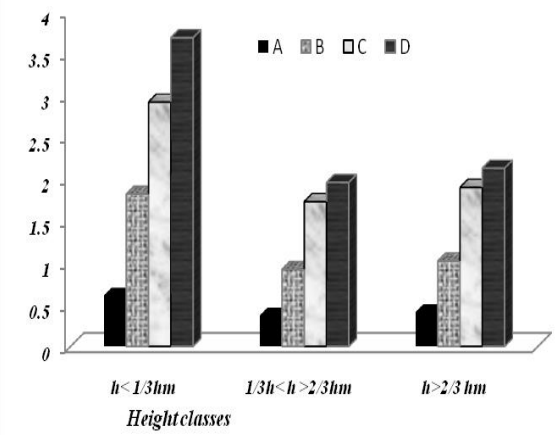

Figure 5. The comparison of diversity indices in height classes by dominant height. A. Simpson, B. Simpson's reciprocal, C. Shannon–Wiener, D. Number of equally common species.

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 difference in low diameter and height classes with up diameter and height 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 needs low light than higher age process in these classes. By the increase of diametrical and height classes, the diversity decrease. It is obvious that the structural diversity naturally in the virgin forest decrease depends 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 another 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 structural diversity and 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 production of forest ecosystems.

CONCLUSION

The increasing 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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