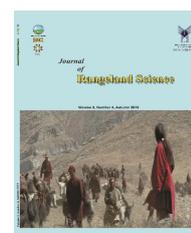


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Studying Biodiversity of Plant Associations in Mount on Ebn-e-Ali in Tabriz, Iran

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Abstract. The aim of this study was to evaluate the biodiversity of plant associations in On Ebn-e-Ali Mountain in Tabriz and its relationship to various biodiversity indices. Four plant associations including 1) *Noaea mucronata- Poetum bulbosa*, 2) *Noaea mucronata-Brometum tomentellus*, 3) related to bush form as well as *Poeto bulbosa-Brometum tomentellus* and 4) *Brometo danthonia - Brometum tomentellus* related to grass form were recognized using Braun-Blanquet and cluster analysis methods in the study area. The biodiversity of different plots was measured based on Richness, Dominance, Evenness, Equitability, Shannon-Weiner, Simpson, Menhinick, Margalef, Fisher's alpha, Brillouin, Berger-Parker and Chao-1 indices in 2017. Associations of 4 and 1 with 19.25 and 14.25 had the highest and lowest richness values, respectively. All of biodiversity variables had strong correlation with the first axes of Principal Component Analysis (PCA). The PCA axes 1 and 2 accounted for 90.8% and 6.2% of the total variation, respectively. The results indicated that high plant diversity in *Brometo danthonia- Brometum tomentellus* (association 4) was due to the high degree of evenness and in *Poeto bulbosa- Brometum tomentellus* (association 3) caused by the high degree of richness. However, high degree of dominance in *Noaea mucronata- Poetum bulbosa* and *Noaea mucronata- Brometum tomentellus* (associations 1 and 2) had led to reduction of their biodiversity. The results showed that there were 75 species belonging to 65 genera and 30 families and 62, 12 and 1 species belonged to dicotyledons, monocotyledons and gymnosperm, respectively. Lamiaceae, Poaceae, Asteraceae, Brassicaceae, Caryophyllaceae and Papilionaceae families comprised 59% of plant species in the study area.

Key words: Richness, Dominance, Evenness, Equitability, PCA

Introduction

Biodiversity represents the variety and heterogeneity of organisms or traits at all levels of the hierarchy of life, from molecules to ecosystems. Typically, the focus is on species diversity, but other forms of diversity such as genetic and chemical diversity are also important and informative (Hurlbert, 1971; Purvis and Hector, 2000). High species diversity indicates that the area is healthier than another area with low species diversity. Biodiversity is discussed by the richness or taxa (number of species), evenness (the number of individuals from each species) and variety of organisms as well as genetic variation within and between species and ecosystems (Burely, 2002; Krebs, 1989). Biodiversity in plant associations supports services such as maintaining the balance of atmospheric gases, recycling nutrients, regulating climate, maintaining hydrological cycles creating soil, etc. Species diversity enhances the productive capacity of many natural ecosystems and their ability to adapt to changing conditions (Macneely, 2002). Greater species diversity does lead to greater stability in ecosystems (Jenkins and Parker, 1998).

Richness means the number of species in a given area like a community or a relevé (plot) used to describe species diversity pattern. High diversity which has been discussed by ecologists refers to a community with a large number of different species. But measure of species diversity is mostly based on richness and evenness in a community or a plot (Kent and Caker, 2001).

Taxonomy is one of the aspects of biodiversity that refers to the intermediate ecological classification system and it is considered as an important indicator to evaluate productivity of ecological systems and the environmental functions (Ejtehadi *et al.*, 2009). Study of diversity of plant associations improves the understanding of ecosystem sustainability and it is useful for sustainable

management strategies (Wilson and Tilman, 2002). Biosphere reserves are unique places to understand how to sustainably manage and govern social–ecological systems, given their integrated approach to conserve biodiversity and promote sustainable development, and their global scope (Borrini-Feyerabend *et al.*, 2013).

Whittaker has identified two types of diversity called alpha and beta. Alpha diversity is the community's richness in species (Whittaker, 1972), and beta diversity is the extent of differentiation of communities along habitat gradients (Whittaker, 1972, Wilson and Shmida, 1984). It means that diversity of a landscape or a geographic area is a product of the alpha diversity of its communities and the degree of differentiation among them is beta diversity while the total number of species (richness) is more popular among the various diversity indices (Magurran, 1988; Shannon-Weiner, 1964) using species richness and evenness than that for others.

The variations in species diversity can be linked to several ecological gradients (Grime, 1979). One of the clearest patterns in biodiversity is its heterogeneous spatial distribution. Altitudinal gradient is well known to be one of the decisive factors shaping the spatial patterns of species diversity (Szaro, 1989). Study of plant species diversity along an altitudinal gradient in western Himalaya showed that the effect of altitude on species diversity displays a hump-shaped curve which may be attributed to an increase in habitat diversity at the median ranges and relatively less habitat diversity at higher altitudes. The anthropogenic pressure at lower altitudes results in low plant diversity towards the bottom of the valley with most of the species being exotic in nature. Though the plant diversity is less at higher altitudinal ranges, the uniqueness is relatively high with high

species replacement rates (Chawla *et al.*, 2008).

The results of climatic control of plant species richness along elevation gradients in the longitudinal Range-Gorge region revealed that values of species richness are higher in the lowlands and then decrease monotonically with increasing elevation in the tropical mountains. The patterns of species density are the same as that in species richness along elevation gradients. The decline in species richness is due to higher temperature and less precipitation in the lowlands of the subtropical mountains. Among the climate variables, actual evapotranspiration as a measurement of water-energy balance has strong relationships with species richness (Yang *et al.*, 2007).

Pourbabaei and Dado (2005) measured different biodiversity indices based on five elevation classes and six different areas according to the tending interventions in Kelardasht forests in Mazandaran Province of Iran. Major ecological factors affecting the species diversity, richness and evenness in the study area were climate, soil condition, elevation and human factors. Results showed that tree species diversity decreased from West to East of Province, and the highest and the lowest biodiversity were related to *Taxus baccata* and *Celtis australis* habitats and *Fagus orientalis* and *Buxus hyrcana* habitats, respectively.

The study of species diversity in four plant ecological groups in Kelarabad Protected Forest in northern Iran indicated that the diversity and evenness have a positive relation. It means that with an increase in evenness, biodiversity has also increased in four ecological groups. Diversity was influenced by conservation programs because there were no slope, altitude and geographic aspect gradients in this study area (Mahmoudi, 2007).

In order to rapid assessment of species diversity for the management programs, finding the appropriate techniques for diversity measurement is very essential. The effect of grazing intensity and aspect on diversity indices using C multi-scale plot in the rangeland ecosystems of Shahrekord, Iran showed that this kind of C multi-scale plots can provide an appropriate estimation of species diversity in different situations (Omidzadeh Ardali *et al.*, 2013).

Study on plant biodiversity in relation to physiographical factors (slope- altitude and aspect) in Afratakhteh Yew (*Taxus baccata* L.) habitat in Iran showed that there was no significant difference between altitude and species diversity. Also, the average measure of richness, diversity indices of Shannon-Weiner and Mc-Arthur and Pielou Evenness were the highest towards the west aspect. Similarly, the average measure of richness, diversity indices of Shannon-Weiner and Mc-Arthur were the highest in 10 to 35% slope (Esmailzadeh *et al.*, 2012).

Investigation of biodiversity in the plant associations in Arasbaran region of Iran showed that indicator species of rangeland associations like *Thymetum kotschyanus* - *Astragaleto aureus* and *Poeto bulbosa-Festucetum ovina* have a positive and direct relationship with Shannon-Weiner, Simpson (1949), Menhinick (1964) and evenness biodiversity indices as well as indicator species of forest associations like *Carpinetum betulus* and *Quercetum macranthera* with Simpson dominance index (Ebrahimi Gajoti *et al.*, 2013).

The objective of the present research was to investigate the biodiversity of rangeland vegetation associations in Mount On Ebn-e-Ali in Tabriz, to determine the relationships between rangeland vegetation associations and biodiversity indices and identify the most effective indices for recognition of different plant associations.

Materials and Methods

On Ebn-e-Ali Mountain with a total area of 1177 ha is located at 38°7'23.68", 38°4'53.43"N latitude and 46°23'4.40", 46°17'28.80" longitude in Tabriz in Northwest of Iran with the elevation range of 1378-1890 m and the average elevation of 1834 m above sea level. According to the 51-year data of meteorological station of Tabriz airport (1963-2014), the area with an annual range precipitation of 148-403 mm and annual mean precipitation of 259.9 mm is classified as a semi-arid region based on De Martonne climate classification (Khaleghi, 2004). Medium textured soil indicated loam clay sandy soil in the case study. The amount of organic matter is rarely 1% that indicates low nutrient content in the soil. Soil pH ranged from 8 and 8.5 which refer to alkaline soils. Electrical Conductivity (EC) varied from 0.44 to 8.5 mhos/cm.

The vegetation classification of Mount On Ebn-e-Ali was carried out based on the Braun-Blanquet approach (Braun Blanquet, 1983). Braun-Blanquet approach is based on physiognomy and ecological-floristic composition. In order to classify the rangeland vegetation, plant formation types were distinguished based on field studies and physiognomy, and different homogeneous plant groups were recognized. Then, sample plots were established based on selective sampling in terms of ecological factors. Finally, 16 sample plots with the minimal area of four and eight m² were selected using nested plot method. However, there are several methods to classify the plots, but Ward's minimum variance method (Ward, 1963) in terms of Euclidean Distance and Second Derivative was identified as the best method in this study. Plots were grouped based on dendrogram obtained by cluster analysis so that different rangeland vegetation associations were recognized in the area. Cluster analysis was implemented using PC-ORD software (McCune and Mefford, 1999).

In addition, the indicator species was also recognized based on fidelity and constancy criteria (Braun Blanquet, 1983).

To study the species diversity, Evenness, Berger-Parker (1970), Dominance, Equitability, Shannon-Weiner (1964), Simpson (1949), Menhinick (1964), Margalef (1985), Fisher's alpha (1943), Brillouin) 1962), and Chao1, 1984-1987) indices were used. Furthermore, biodiversity indices were calculated based on the presence, absence and abundance of species in selected sample plots where data collection was carried out in 2017. Among the various indices calculated in this study, the total number of species (species richness) was used to show the presence of species.

Evenness refers to the distribution and population of individuals of each species. More evenness value identifies more homogenous distribution of species in terms of the percentage of canopy cover in the plot. In addition, more homogeneous distribution of species (the same number of individuals or the abundance of different species) implies higher diversity. The higher the biodiversity of an ecosystem, the more sustainable it is. Shannon-Weiner (Equation 1) and Simpson (Equation 2) indices were used to calculate the evenness (Barnes and Zak, 1998) in this study.

$$EH = H/H_{max} = \sum_{i=1}^s p_i \ln p_i / \ln(s)$$

(1)

$$ED = 1 / \sum_{i=1}^s (p_i)^{2*s}$$

(2)

Dominance indicates the abundance of a species as compared to others. Simpson index (Equation 3) was used to calculate the dominance (Barnes and Zak, 1998).

$$D = \sum_{i=1}^s (p_i)^2$$

(3)

Where:

H = Shannon diversity index

H_{max} = ln(s)

S= total number of species

P_i = proportion of S made up of the i th species

\ln = natural logarithm

Species diversity index can refer to a community with low richness and high evenness or a community with high richness and low evenness. It does not thus reveal the biodiversity of an area. Species diversity index is a combination of species richness and evenness. Therefore, the species diversity index contains species richness and evenness indices together. Biodiversity indices were assumed as environmental variables and were analyzed using PAST and PC-ORD Ver. 4.17 software (McCune and Mefford, 1999).

In order to investigate the relationship between sample plots distribution and biodiversity indices as well as determination of the most effective indices for recognition of different plant associations, we used Principal Component Analysis (PCA) which is a direct ordination technique for finding the relationship between environmental variables and species data by PCA graphs

(Kent and Caker, 2001) through regression and correlation (Ter Braak and Prentice, 1988).

Results

The rangeland vegetation classification of On Ebn-e-Ali Mountain was carried out based on the Braun-Blanquet approach. Based on the cluster analysis, four rangeland plant associations were distinguished in the study area including *Noaea mucronata*- *Poetum bulbosa* and *Noaea mucronata*- *Brometum tomentellus* related to bush form as well as *Poeto bulbosa*- *Brometum tomentellus* and *Brometo danthonia* - *Brometum tomentellus* related to grass form (Fig. 1).

In other words, the *Poa bulbosa* L. and *Noaea mucronata* (Forssk.) (Aschers & Sch.) were indicator species of association1 as well as *Bromus tomentellus* Boiss. and *Noaea mucronata* (Forssk.) Aschers & Sch. for association2, *Bromus tomentellus* Boiss. and *Poa bulbosa* L. for association3, and *Bromus tomentellus* Boiss. and *Bromus danthonia* Trin. for association4.

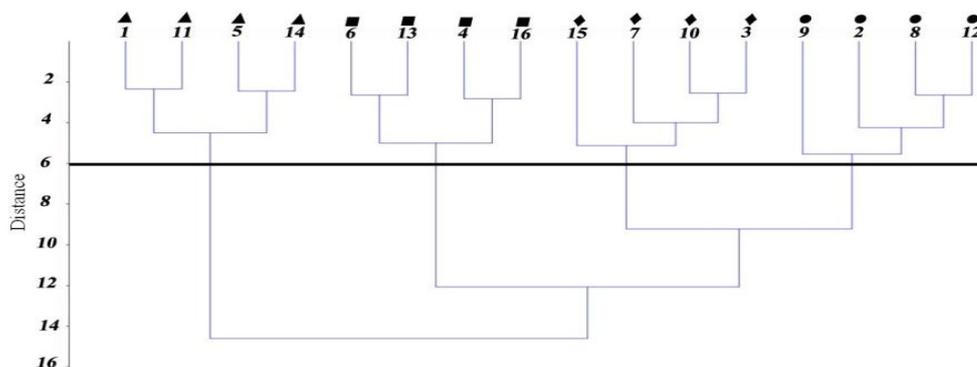


Fig. 1. Dendrogram of cluster analysis of distinguished plant associations based on the presence of species (▲: *Noaea mucronata* - *Poetum bulbosa*, ■: *Noaea mucronata* - *Brometum tomentellus*, ◆: *Poeto bulbosa* - *Brometum tomentellus*, ●: *Brometo danthonia*- *Brometum tomentellus*)

Descriptive statistics of biodiversity indices were calculated based on four given associations (Table 1). According to the results, the average of three Dominance, Evenness and Berger-Parker indices in associations 1 and 2 were higher than in associations 3 and 4. However, Shannon-Weiner, Simpson,

Menhinick, Margalef, Fischer's alpha, Brillouin, Chao 1, Richness and Equitability indices were higher in associations 3 and 4 than associations 1 and 2. Associations 4 and 1 with values of 19.25 and 14.25 had the highest and lowest richness, respectively.

Table 1. Biodiversity indices descriptive statistics in different associations in the study area

Plant Association	Descriptive statistics	Dominance_D	Simpson_1-D	Shannon_H	Evenness_e^H/S	Brillouin	Menhinick	Margalef	Equitability_J	Fisher_alpha	Berger-Parker	Chao-1	Taxa_S
1	Min	0.080	0.907	2.476	0.915	1.807	3.064	4.152	0.965	21.00	0.150	22.0	13.0
	Max	0.092	0.920	2.623	0.918	1.923	3.354	4.673	0.968	27.26	0.166	28.75	15.0
	Mean	0.084	0.915	2.568	0.917	1.880	3.246	4.478	0.967	24.88	0.156	26.18	14.25
	SEM	0.003	0.003	0.035	0.001	0.027	0.069	0.124	0.001	1.502	0.003	1.62	0.478
2	Min	0.069	0.920	2.589	0.950	1.849	3.395	4.588	0.980	37.18	0.105	27.75	14.0
	Max	0.079	0.930	2.726	0.954	1.961	3.671	5.094	0.983	47.85	0.117	35.5	16.0
	Mean	0.074	0.925	2.658	0.952	1.905	3.534	4.842	0.981	42.43	0.111	31.56	15.0
	SEM	0.002	0.002	0.027	0.001	0.022	0.056	0.103	0.001	2.17	0.002	1.58	0.401
3	Min	0.052	0.930	2.718	0.947	1.978	3.578	5.007	0.980	37.14	0.080	29.2	16.0
	Max	0.070	0.947	2.997	0.953	2.209	4.200	6.213	0.984	61.92	0.110	48.2	21.0
	Mean	0.06	0.94	2.875	0.950	2.108	3.925	5.675	0.982	50.39	0.088	39.35	18.75
	SEM	0.003	0.003	0.057	0.001	0.047	0.128	0.249	0.001	5.082	0.004	3.89	1.036
4	Min	0.052	0.935	2.788	0.955	2.013	3.801	5.341	0.984	53.68	0.083	39.75	17.0
	Max	0.065	0.947	3.005	0.961	2.196	4.287	6.293	0.986	80.34	0.100	59.25	21.0
	Mean	0.057	0.942	2.911	0.958	2.116	4.075	5.877	0.985	68.52	0.090	50.62	19.25
	SEM	0.003	0.003	0.055	0.001	0.046	0.124	0.244	0.001	6.921	0.004	5.06	1.03

Correlation of biodiversity variables with the PCA axes 1 and 2 is shown in Table 2. The highest correlation values for all of indices were observed in axis1. According to Table 2, the PCA principal axes 1 and 2 accounted for 90.8 and 6.2% of the total variation, respectively. Based on eigenvalues of 10.9 and 0.74 for the axes 1 and 2, and axis 1 was identified as the highest degree of variation and vegetation differentiations.

Table 2. Correlation of biodiversity variables with the PCA principal axes 1 and 2

Biodiversity indices	F1	F2
Dominance_D	-0.984	0.035
Simpson_1-D	0.986	0.005
Shannon_H	0.984	-0.166
Evenness_e^H/S	0.823	0.545
Brillouin	0.952	-0.292
Menhinick	0.996	-0.075
Margalef	0.984	-0.171
Equitability_J	0.883	0.391
Fischer's alpha	0.973	0.072
Berger-Parker	-0.943	-0.239
Chao-1	0.956	-0.124
Taxa_S	0.962	-0.266
Eigenvalue	10.908	0.747
Variability (%)	90.899	6.227
Cumulative %	90.899	97.12

Ordination method of PCA was also applied to find the most effective biodiversity indices for plant association recognition. Fig. 2 shows the relationship between biodiversity variables and selected sample plots based on axes 1 and 2. The distance between the plot points shows a degree of similarity or dissimilarity of species composition and biodiversity.

According to Fig. 2, Fischer's alpha, Simpson, Evenness, Equitability and Menhinick indices had a direct relationship with association 4 including plots 2, 8, 9 and 12 (*Brometo danthonia-Brometum tomentellus*). Similarly, Menhinick, Chao1, Shannon-Weiner, Margalef, Richness and Brillouin indices had a direct relationship with association 3 including plots 3, 7, 10 and 15 (*Poeto bulbosa-Brometum tomentellus*), and Dominance and Berger-Parker indices with association1 including plots 1, 5, 11 and 14 (*Noaea mucronata-Poetum bulbosa*) and Dominance index had a direct relation with association 2 including plots 6, 13, 4 and 16 (*Noaea mucronata- Brometum tomenteli*).

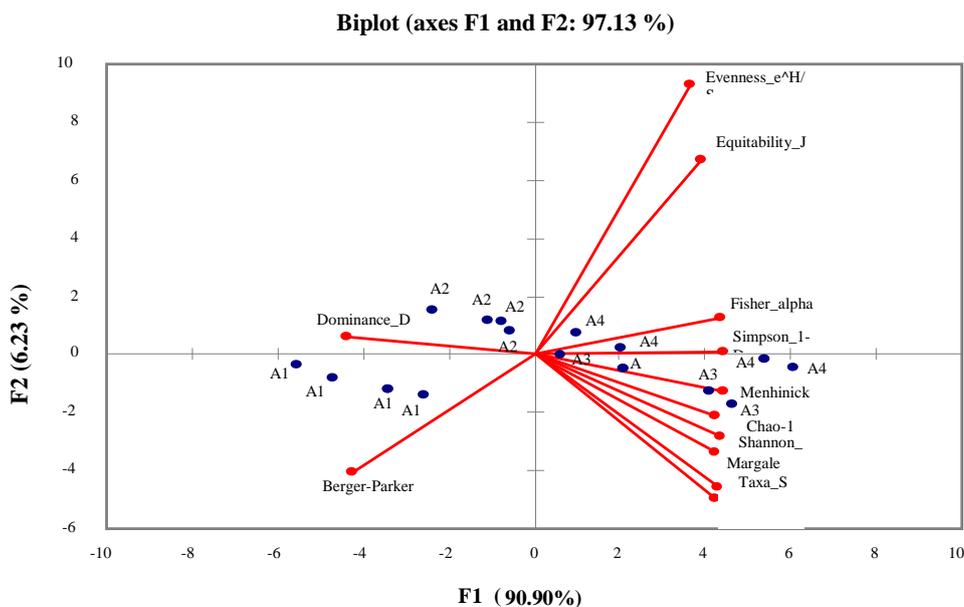


Fig. 2. Relations between biodiversity variables and plant associations based on axis1 and 2 (*A: Association)

A1: (P₁, P₅, P₁₁, P₁₄), A2: (P₄, P₆, P₁₃, P₁₆), A3: (P₃, P₇, P₁₀, P₁₅) and A4: (P₂, P₈, P₉, P₁₂).

The results showed that there were 75 species belonging to 65 genera and 30 families, from which 62, 12 and 1 species belonged to dicotyledons, monocotyledons and gymnosperm,

respectively. As shown in Fig. 3, Lamiaceae, Poaceae, Asteraceae, Brassicaceae, Caryophyllaceae and Papilionaceae families comprised 59% of plant species in the study area (Fig. 3).

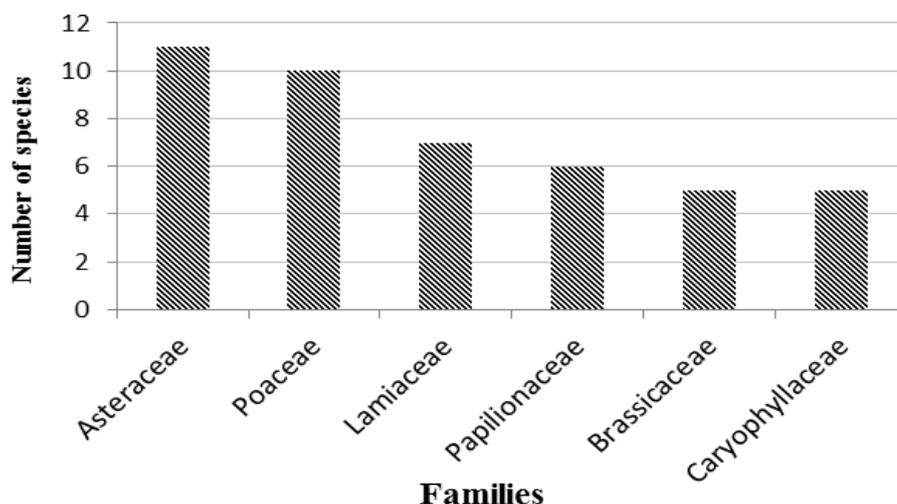


Fig. 3. Families with the most species frequency in the study area

Discussion

The results of PCA showed that plant associations differed not only in terms of floristic characteristics, but also in terms of biodiversity. Therefore, the classification of the plant habitat based on cluster analysis and PCA method was in accordance with the vegetation of the

study area. From this, it can be argued that multivariate statistical methods can be used to identify the relationship between sample plots or plant associations with biodiversity indices. The obtained results can be used for improvement of management and rangeland reclamation in similar areas. Naderi and Sharafatmandrad (2017)

classified Khod-Neuk steppe rangeland in Iran to 5 ecological groups based on the presence-absence and canopy cover of plant species and investigated their relationships with plant diversity indices. The diversity indices including species richness, Shannon-Wiener evenness index, Simpsons' dominance index, Shannon-Wiener diversity index and Simpsons' diversity index were analyzed. The ecological groups were quite different in terms of species composition and plant diversity indices. Therefore, these groups are enough to delineate rangeland into ecological units which could be used for management purposes.

Among the biodiversity indices, Menhinick and Simpson index vectors had the smallest angles with axis 2. According to Table 2, the strong correlation values as 0.996 and 0.986 were related to Menhinick and Simpson indices with axes 1, respectively. It can be therefore concluded that these indices as environmental factors affected plant distribution and plant association recognition more than the others in the study area. It was followed by Shannon-Weiner, Margalef, Dominance, Fischer's alpha and Richness indices, respectively.

Investigation of the biodiversity indices of the plant associations in the study area showed that Fischer's alpha, Simpson, Evenness, Equitability and Menhinick indices had a direct relationship with all plots 2, 8, 9 and 12 of association 4 (*Brometo danthonia-Brometum tomentellus*). It clearly indicates that an increase in the mentioned indices will lead to species development in related association. Furthermore, Menhinick, Chao1, Shannon-Weiner, Margalef, Richness and Brillouin indices had a direct relation with all plots 3, 7, 10 and 15 of association 3 (*Poeto bulbosa- Brometum tomentellus*), and Dominance and Berger-Parker indices had a direct relation with all plots 1, 5, 11 and 14 of association 1 (*Noaea mucronata - Poetum*

bulbosa). The results also represent that Dominance index had a direct relationship with all plots 6, 13, 4 and 16 of association 2 (*Noaea mucronata - Brometum tomentellus*). Findings of this study revealed that with an increase in these indices, the species will be developed easily in these associations. On contrary, a decrease in indices values may result in establishment and propagation limitation of species. However, Jankju and Noedoost (2014) showed that a 22 year abandoned ploughed site had increased the total number of plant species (richness) but decreased the species heterogeneity (evenness). Ploughing had increased (8%) sprouting of plant species. Furthermore, there were some increases in number of therophytes (100%) but hemicryptophytes (24%), chamaephyte (33%) and phanerophyte (100%) species were reduced in the abandoned site. Thus, it is possible to deduce that lower evenness and high proportion of annual plants make the abandoned site more fragile and sensitive against the future environmental fluctuations.

The results of this research confirmed that high plant diversity in *Brometo danthonia- Brometum tomentellus* association (4) was a result of high degree of evenness and in *Poeto bulbosa- Brometum tomentellus* association (3) caused by high degree of richness. It clearly indicates that species diversity indices may refer to a community with low richness and high evenness or a community with high richness and low evenness and it is not only enough to reveal the biodiversity of an area (Kent and Caker, 2001). In fact, species diversity index is mostly based on richness and evenness (Krebs, 1989). Lakićević and Srđević (2018) calculated richness and evenness with the most commonly used biodiversity indices including Shannon, Simpson, Margalef and Berger-Parker for four forest communities to discover a similarity

between the analyzed forest communities. Calculating and analyzing these indices is useful not only for forest ecosystems, but also for the other types of ecosystems including agro-ecosystems. This type of data and analysis are extremely important to characterize ecosystems.

The high degree of dominance in *Noaea mucronata-Poetum bulbosa* and *Noaea mucronata-Brometum tomentellus* associations (1 and 2) has reduced the biodiversity of these associations. Accordingly, the dominance of some species has reduced the richness, evenness and species diversity in these associations and has limited the presence and distribution of the other species.

According to the results, there were 75 species belonging to 65 genera and 30 families in the study area from which 62, 12 and 1 species belonged to dicotyledons, monocotyledons and gymnosperm, respectively. Species richness mostly assumed to be the diversity (Magurran, 1988) under the influence of climatic and soil conditions in the area.

Consequently, there was a specific relationship between the biodiversity indices and plant association recognition. So, biodiversity indices and ecological factors were effective in development of current associations in the study area. Similar studies have been conducted on the effects of environmental factors and biodiversity indices on the plant composition and association recognition by other researchers (Mahmoudi, 2007; Ebrahimi Gajoti et al., 2013; Abu Ziada et al., 2008; Mashaly et al., 2001; Esmailzade et al. 2012; Marini et al, 2007).

This research found that high plant diversity in *Brometo danthonia-Brometum tomentellus* (association 4) was due to high degree of evenness and in *Poeto bulbosa- Brometum tomentellus* (association3) caused by high degree of richness. However, high degree of dominance in *Noaea mucronata- Poetum*

bulbosa and *Noaea mucronata-Brometum tomentellus* (associations 1 and 2) had led to reduction of their biodiversity. Results showed that Lamiaceae, Poaceae, Asteraceae, Brassicaceae, Caryophyllaceae and Papilionaceae families comprised 59% of plant species in the study area.

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بررسی تنوع زیستی جوامع گیاهی در کوه عون بن علی تبریز

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چکیده. هدف این مطالعه بررسی تنوع زیستی جوامع گیاهی کوه عون بن علی تبریز و ارتباط این جوامع با شاخص‌های مختلف تنوع زیستی می‌باشد. در ناحیه مورد مطالعه با تکیه بر روش بران بلانکه و بر اساس آنالیز خوشه‌ای، چهار جامعه گیاهی شامل (۱) *Noaea mucronata- Poetum bulbosa* و (۲) *Noaea mucronata- Brometum tomentellus* مربوط به فورماسیون بوته‌زار و (۳) *Poetum bulbosa- Brometum tomentellus* و (۴) *Brometum danthonia - Brometum tomentellus* مربوط به فورماسیون علفزار از هم تفکیک گردید. تنوع زیستی پلات‌های مختلف بر اساس شاخص‌هایی نظیر غنا، غالبیت، یکنواختی، تعادل، شانون وینر، سیمپسون، منهنیک، مارگالف، فیشر، برلیون، برگر پارکر و چائو در سال ۱۳۹۶ محاسبه گردید. جوامع ۴ و ۱ به ترتیب با ۱۹/۲۵ و ۱۴/۲۵ گونه بیشترین و کمترین غنا را دارا بودند. میزان همبستگی شاخص‌های تنوع زیستی با محورهای ۱ و ۲ نشان داد که همه شاخص‌ها بیشترین میزان همبستگی را با محور ۱ داشتند. بطوری‌که سهم مولفه‌های ۱ و ۲ به ترتیب ۱۰/۹ و ۶/۲ درصد از کل تغییرات می‌باشد که با مقادیر ویژه مربوط به محورهای ۱ و ۲ به ترتیب ۱۰/۹ و ۰/۷۴ هم‌خوانی دارد. محور ۱ بیشترین سهم از تغییرات و اختلاف پوشش گیاهی را توجیه نمود. بالا بودن میزان تنوع زیستی در جامعه ۴ ناشی از بالا بودن میزان شاخص یکنواختی و در جامعه ۳ ناشی از بالا بودن میزان شاخص غنا می‌باشد. ولی در مقابل بالا بودن میزان شاخص غالبیت در جوامع ۱ و ۲ موجب کاهش تنوع زیستی در آنها گردید. بررسی پوشش گیاهی نشان داد که جمعاً تعداد ۷۵ گونه در حوزه مورد مطالعه وجود دارد که به ۶۵ جنس و ۳۰ تیره تعلق دارند. از این تعداد ۶۲ گونه، دولپه‌ای، ۱۲ گونه، تک لپه‌ای و ۱ گونه از بازدانگان می‌باشند. ۵۹ درصد از گونه‌های این منطقه مربوط به خانواده‌های Poaceae, Lamiaceae, Brassicaceae, Asteraceae و Papilionaceae می‌باشد.

کلمات کلیدی: روند تخریب، پوشش مرتع، روزهای غباری، زنجیره مارکف، ایران