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Study of Plant Biodiversity in Grazed and Non-grazed Areas in the Iran-o-Turanian Ecological Zones (Case Study: Yazd Province, IRAN)

Maziar Haidari[1*], Hamid Jalilvand[2], Reza Hossaein Haidari[3], Naghi Shabanian[4]

[1] Young Researchers Club, Sanandaj Branch, Islamic Azad University, Sanandaj, Iran*
[2] Department of Forestry, Sari University of Agricultural Sciences and Natural Resources, sari, Iran, [3] Department of Forestry, University of Razi, Kermanshah, Iran
[4] Department of Forestry, University of Kurdistan, Sanandaj, Iran.

ABSTRACT

Species diversity is one of the most important indices was used to evaluate the sustainability of forest communities. In this study, the effect of complete protection (non-grazed) on plant species diversity was investigated in Bagh-e-Shadi Forest (Irano-Turanian Forest), Yazd province, central of Iran. For this purpose, sampling designed the randomized-systematic method with rectangular plots that were 40×50 meters in the 100×200 Net, Shrub species in the 100 square (10×10 meter) and Herb species in the 25m^2 (5×5 meter) were sampled in the center of net inventory. In the total 60 sample plots (30 plots in the grazed and 30 plots in the non-grazed area) were sampled. In every sample plot recorded plant species and number of this plant. In order to analyze biodiversity indicators of Shannon-Wiener and Simpson as well as Margaleff evenness indices was applied. Results indicated that Gramineae, Compositae, Labiatae, Rosacae and Anacariaceae families have the highest number of species. Pistacia atlantica and Amygdalus communis were the most dominant woody plants for class of tree and Acantholimon sp. and Astragalus spp were the most dominant Shrub plants, respectively. Bromus tectorum and poa sinacia were dominant herbaceous species. Herbaceous layer had the highest richness, evenness and diversity. The differences between biodiversity indexes in the two areas were statistically significant in the tree, shrub and herbaceous layer. So the grazed and non-grazed increase tree, shrub and herbaceous diversity in Irano-Turanian forest, and complete protection (non-grazed) area have higher plant diversity compered the grazed region. Therefore, prevention of livestock grazing and irregular tree cutting in the degraded forest stands can be suggested as a suitable approach for natural restoration and increasing plant diversity.

Key words: Iran, Yazd Province, Tree, Bush, herbaceous, Vegetation Layer.

INTRODUCTION

I.R. of Iran is located in the North Temperate Zone from 25 to 40 latitude and 44 to 63 longitude degrees, with a total area approximately 1,650,000 Km2. A large section of interior is characterized by arid basins. Climatic variations are also great in Iran. The main variation is between the dry, desert interior region and humid Caspian coastal region (24). With due to attention to climatic conditions of Iran, 65% area includes arid and semi-aireid and degradation rapid of north and west, because of degradation of natural resources will cause to degradation agricultural lands and human environmental (6). Forests cover about 12 million ha in Iran (Forest and Rangeland Organization 2002), The Irano-Turanian region covers an area of about 3,452,775 ha with dry and mainly cold climate in winter. They are situated in Khorasan, Azarbaijan, Markazi and westem Provinces. Regarding to topographical conditions and diversity of species, the region is divided into plain and mountainous sub - regions. Plain sub – regions located in the less 2000 meter a.s.l and main tree is Pistacia Forests. Pistacia Forests include

scattered patches of open degraded forests, in the region of low rainfall (100 to 150 mm) central and southern of Iran (The Irano-Turanian of arid and semi-arid part, approximately 3.1 million hectares) and on the estern hills along the Afghanistan border. It has a few plant species mainly *Pistacia* spp., *Amygdalus* spp. and *Berberis* spp. (13). Biodiversity is defined as the kinds and numbers of organism and their patterns of distribution (22). Generally, biodiversity measurement typically focuses on the species level and species diversity is one of the most important indices which are used for the evaluation of ecosystems at different scales (3). Local diversity can be studied with various indices, such as number of species per unit area (species richness) or the Shannon index, amongst other. These are used as indicators of the degree of complexity of the under study communities and provide information on the homeostatic capacity of the system to unforeseen environmental changes (16). Comparison of plant diversity, richness and evenness indices around protected area of the Bazangan Lake in Khorasan province, northeast of Iran indicated that the highest value in Shannon-Wiener index in the protected area (9). The Comparison of tree species diversity in two protected and non-protected area in protected regions of Oshtorankooh in Lorestan province, west of Iran. Indicated trees and shrubs living in the protected regions have species significantly higher diversity, richness, evenness and better living conditions than they are living in non-protected region (1). The study effects of livestock grazing on ground flora in broadleaf woodlands in Northern Ireland indicated cover of dominant species, such as bramble *Rubus fruticosus* agg, an increase in ruderal species and bare ground to be associated with grazed woods (17). Measurement of Shannon-Wiener and evenness indices on *Pinus massoniana* communities in Conservation project of plant biodiversity in Yangtze Three Gorges reservoir area, China showed that biodiversity of shrubs layer was the highest, followed by grass layer and the middle, while tree layer was the lowest (23). The investigation of biodiversity indices (Simpson, Menhinick richness and Peet's evenness) of woody species in mixed coniferous stand of *Pinus nigra-Picea abies* and natural broad-leaved coppice stand revealed that the most number of native species was recorded in natural broadleaved coppice stand, but richness and evenness indices had lower value in natural forest (Memarian et al. 2007). The objective of this study was the investigation and comparison of the effects of complete protection (non-grazed) on plant species diversity (Tree, Shrub and Herbaceous) in Baghe-Shadi forest, Khatam region, Yazd province, Center of Iran.

MATERIAL AND METHODS

Study area:

Iranian habitats support about 8000 species of flowering plants (belonging to 167 families and 1200 genera), of which almost 1700 are endemic (7). These plant species growing on four Ecological Zones (Figure 1).

Figure 1. Distribution of four ecological zones of Iran

To compare trees diversity in the two grazed and non-grazed forest, Baghe-shady forest located in Khatam city (it has the preservative regions that they are 20 years old), Yazd province, Central of Iran (Figure 2). Two areas include complete protection (non-grazed) and grazed area was selected. The study area that was 120 ha (60 ha in the non-grazed and 60 ha in the grazed area (non-protection). The high pressure of cattle cause to sever damages to pistachio and almond. About 20000 to 25000 cattle are in this region in which they cause to sever damages to tree and shrub (25). The main woody species in Baghe-Shadi are *Pictacia khinjuk*, *Pistacia mutica*, *Amygdalus communis*, *Amygdalus scoparia*, *Acer monspessulanum* and *Crataegus* sp. The dominant species in our research area is *Pistacia khinjuk*. Herbaceous vegetation in the forest encompasses *Bromus tectorum*, *Stipa barbata*, *Stachys* sp. and *Hordeum* sp. The climate is very dry; Mean annual air temperature is 17.4°C. The region receives 227 mm of precipitation annually. Climate of the region is semi-arid and arid.

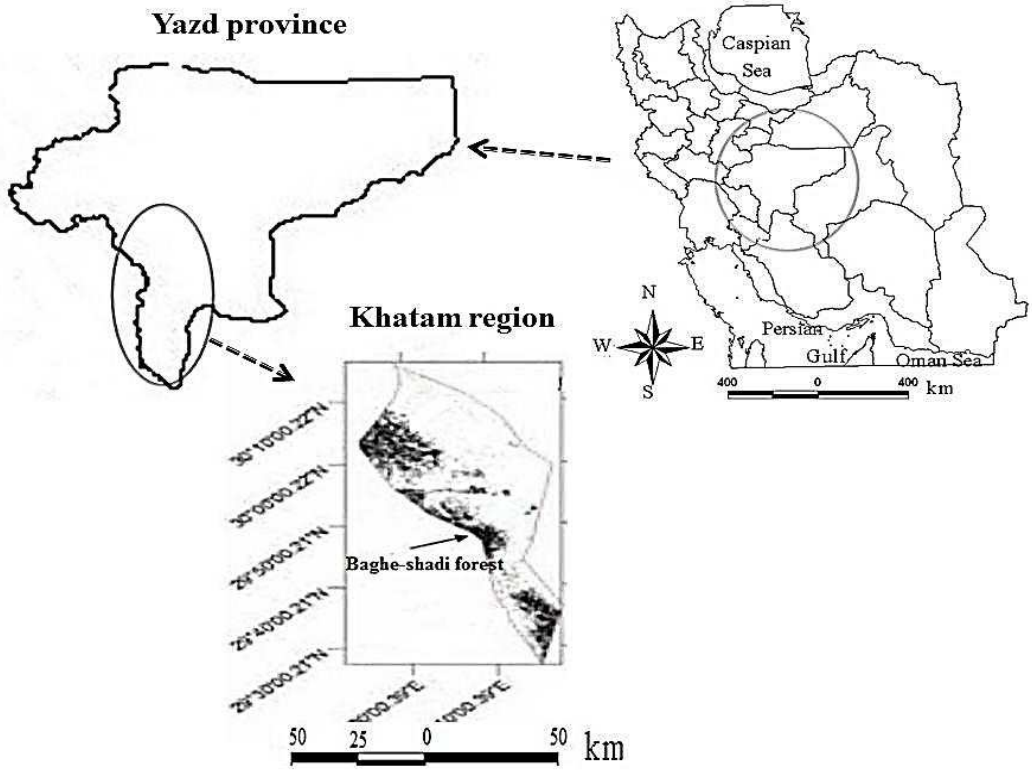

Figure 2. Location of study area, Baghe-Shadi Forest, Yazd Province, Central of Iran

Data collection and analysis:

For this purpose, 60 sample plots (30 plots in the grazed and 30 plots in the non-grazed area) were sampled by a randomized-systematic method with rectangular plots that were 40×50 meters in the Net 100*200 meters. Shrub species in the 100 square meters (10*10 meter) and Herb species in the 25 square meters (5*5 meter) were sampled. In every sample plot recorded plant species and number of this plant (DBH of tree species cm). In order to analyses of biodiversity was applied heterogeneity Indicators of Shannon Wiener and Simpson as well as evenness by using Margaleff indices (Table 1). T-test was used to analysis all indices means differences between grazed and non-grazed area. To analysis data use the Pest software.

Table 1: Biodiversity Indices used in this paper

Indices	References	Equation
Shannon's (H')	Peet, 1974 [20]	$H' = \sum_{i=1}^{S} pi \ln(pi)$
Simpson (1-D)	Peet, 1974 [20]	$1 - D = (\sum (pi)^2$
Margaleff	Peet, 1974 [20]	$M = \frac{S-1}{Ln\ (N)}$
S: the total number of species in the sample	pi: the proportion of individuals in the its species	

Results

The Tree species identified in the region studied belonged to 16 tree species and 10 Family (Table 1). The classes Gramineae with 8, Compositae with 5, and Labiateae with 5, Rosacae with 5 and Anacariaceae with 3 species had the most plants species in the region. *Pistacia atlantica* and *Amygdalus communis* were the most dominant woody plants for class of tree, respectively. *Bromus tectorum* and *Poa sinacia* were dominant herbaceous species.

Table 2. List of plant species (Tree, Shrub and Herbaceous) in the studied areas

Vegetation layers	Scientific name	Family name	Cerotype	Grazed area	Non-grazed area
Tree layer	Pistacia atlantica Desf	Anacariaceae	Prennial	+	+
	Pistacia khinjuk stocks	Anacariaceae	Prennial	+	+
	Amygdalus communis L	Rosacae	Prennial	+	+
	Amygdalus scoparia Spach	Rosacae	Prennial	-	+
	Acer monspessulanum L.	Aceraceae	Prennial	+	+
	Crataegus Persica C. Koch.	Rosacae	Prennial	+	+
	Tamarix Kotschyi Bge	Tamaricaceae	Prennial	-	+
	Ephedra procera	Ephedraceae	Prennial	-	+
	Daphne mucronata Royle	Thymelaceae	Prennial	-	+
	Petropyrum aucheri Jaub & Spach	Polygonaceae	Prennial	-	+
	Cerasus mahalab Miller	Rosacae	Prennial	-	+
	Cotoneaster morulus pojark	Rosacae	Prennial	-	+
	Rhamnus pallasiin Fisch Et Mey	Rhamnaceae	Prennial	-	+
	Zygophyllum europterum	Zygophyllaceae	Prennial	-	+
	Berberis vulgaris	Berberidaceae	Prennial	-	+
	Rhus coriaria L.	Anacariaceae	Prennial	-	+
Bush layer	Acantholimon festucaceum Boiss	Plumbaginaceae	Perennial	+	+
	Ebenus stellata	Papilionaceae	Annual	-	+
	Convonvulus acanthocladus	Convonvulaceae	Annual	-	+
	Artemisia persica Boiss	Compositae	Perennial	+	+
	Cousinia piptocephala	Compositae	Perennial	-	+
	Astragalus spp.	Papilionaceae	Perennial	+	+
	Lactuca orientalis Boiss	Compositae	Perennial	-	+
	Noea mucronata	Chenopodiaceae	Perennial	-	+
	Stachys inflata	Labiatae	Perennial	-	+
	Cousinia desertii	Compositae	Annual	-	+
	Zataria multiflora	Labiatae	Perennial	-	+
	Prangos ferulacea	Umbelliferae	Perennial	-	+
	Silene sp.	Caryophyllaceae	Perennial	-	+
	Nepeta Glumerosa	Labiatae	Perennial	+	+
	Acanthophylium caespitosum Boiss	Caryophyllaceae	Perennial	+	+
	Galium sp.	Rubiaceae	Perennial	+	+
	Polygonum spp.	Polygonaceae	Perennial	-	+
	Rubia florida	Rubiaceae	Perennial	-	+
	Picris strigosa M. B.	Compositae	Perennial	-	+
Herb layer	Iris sogarica	Iridaceae	Annual	-	+
	Bromus tectorum	Gramineae	Annual	+	+
	Boissiera squarrosa	Gramineae	Annual	-	+
	Stipa barbata	Gramineae	Annual	+	+
	Stachys sp.	Labiatae	Annual	+	+
	Phaomis aucheri	Labiatae	Annual	-	+
	Heteranthelium sp.	Gramineae	Annual	-	+
	Eryngium bunngi	Umbelliferae	Annual	-	+
	Poa sinacia	Gramineae	Annual	+	+
	Peganum harmala	Zygophyllaceae	Annual	+	+
	Hordeum sp.	Gramineae	Annual	+	+
	Verbascum sp.	Scrophulariaceae	Annual	+	+
	Avena fatua	Gramineae	Annual	+	+
	Psathyrostachys fragilis		Annual	-	+
	Ferula gumosa	Umbelliferae	Annual	-	+
	Prangus ferulacea	Umbelliferae	Annual	-	+
	Melica spp.	Gramineae	Annual	+	+
	Consolida sp.	Ranunculaceae	Annual	+	+
	Eremurus persicus	Liliaceae	Annual	-	+

Results of table 1showed that this forest has 54 plant species, which consist of 16 trees, 19 shrubs and 19 herbaceous species.

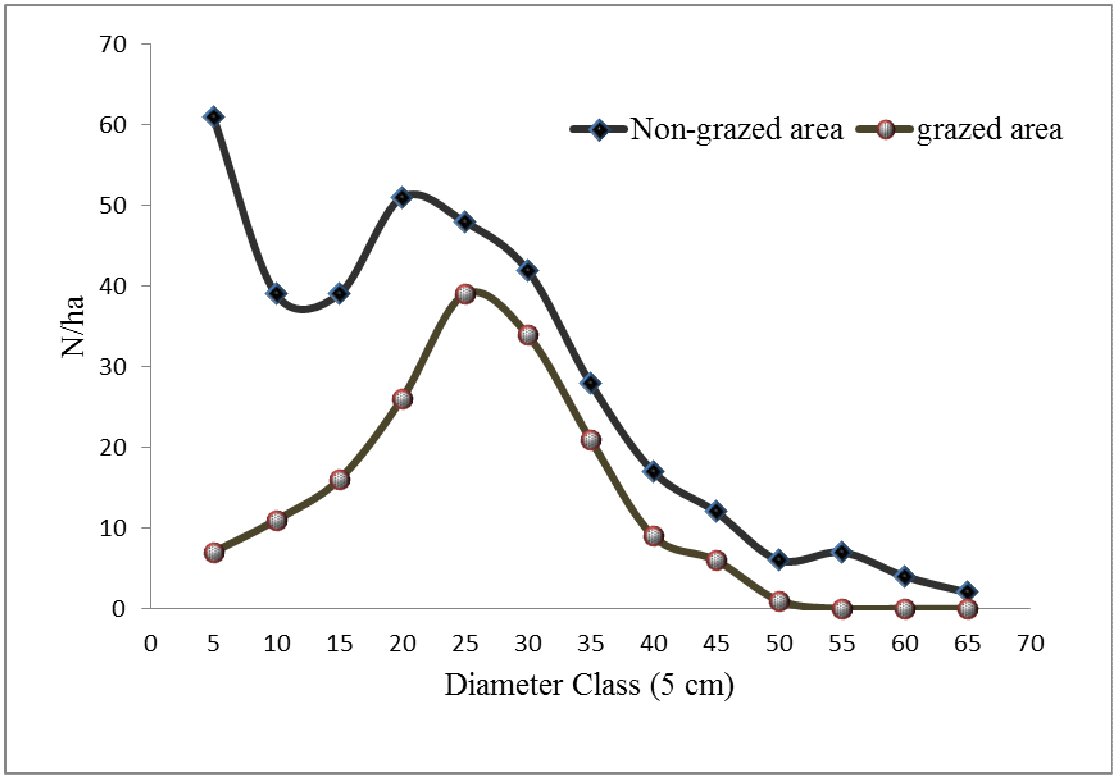

Figure 3. Diameter distribution of tree on the two grazed and non-grazed area.

Diameters of trees in the grazed area were measured at breast high and recorded in 5 cm classes. Large amount of trees occurring on the plots, mostly *Pistacia atlantica* and *Amygdalus communis*. We measured trees ranging from 5 to 50 cm in the grazing area and 5 to 65 cm DBH (Diameter Breath Height) in the non- grazing area.

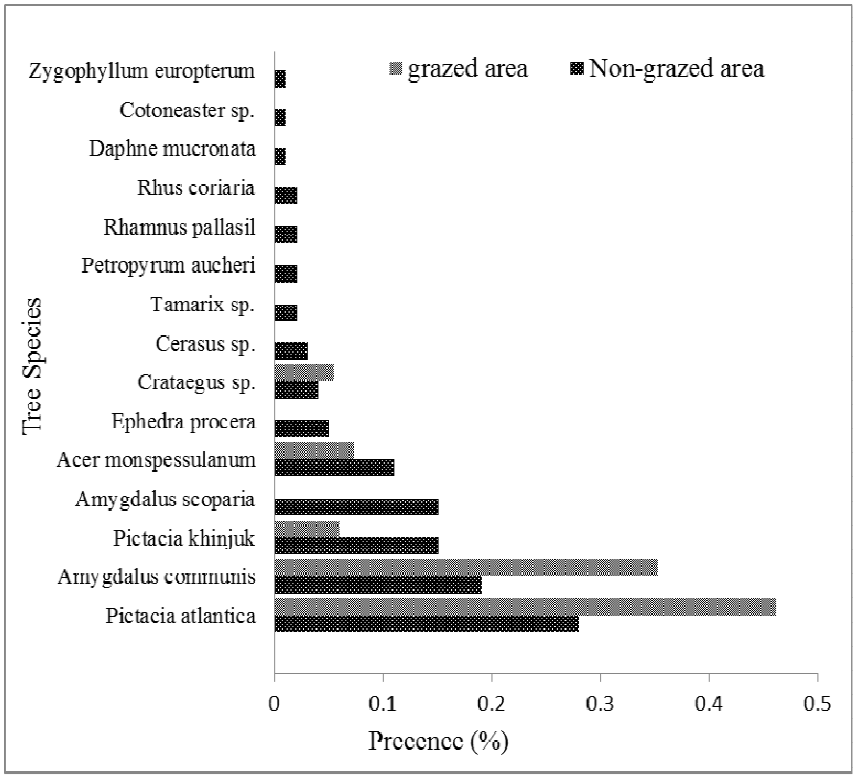

Figure 4. Comparison of tree Percent in the two grazed and non-grazed area

Results of Figure 4 showed 16 and 5 tree species observed in the non-grazed and grazed area. *Pistacia atlantica* and *Amygdalus communis* were the most dominant woody plants in this area.

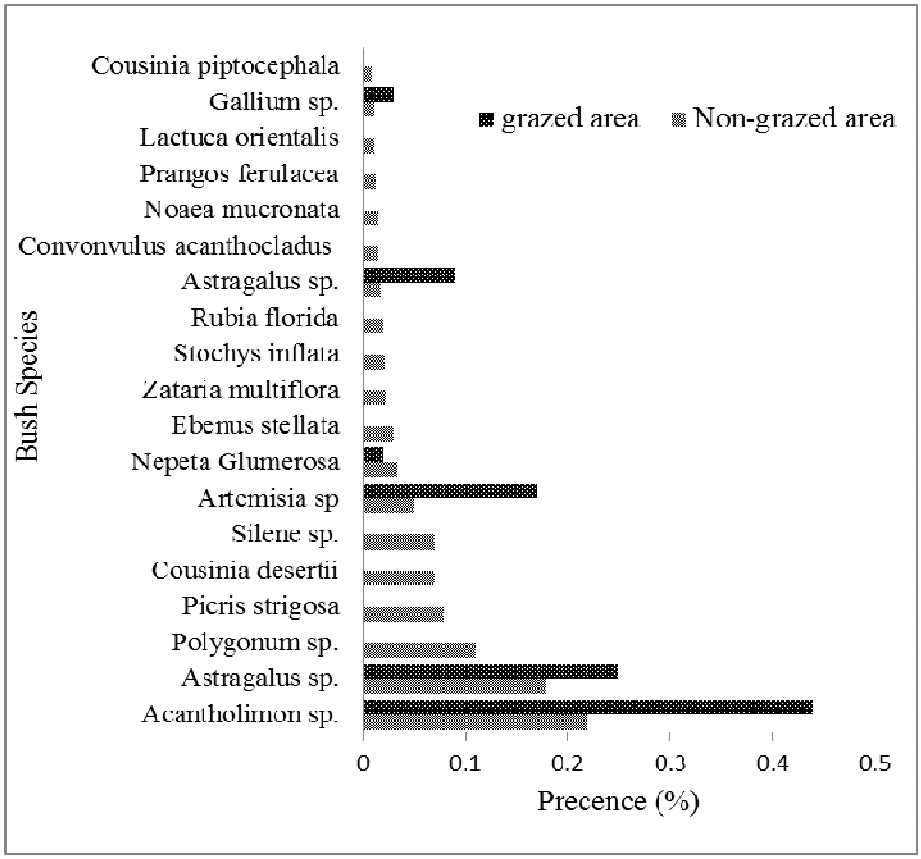

Figure 5. Comparison of Bush species Percent in the two grazed and non-grazed area.

Results of Figure 5 showed 19 and 6 Shrub species observed in the non-grazed and grazed area. *Acantholimon* sp. and *Astragalus* sp were the most dominant Shrub plants in this area.

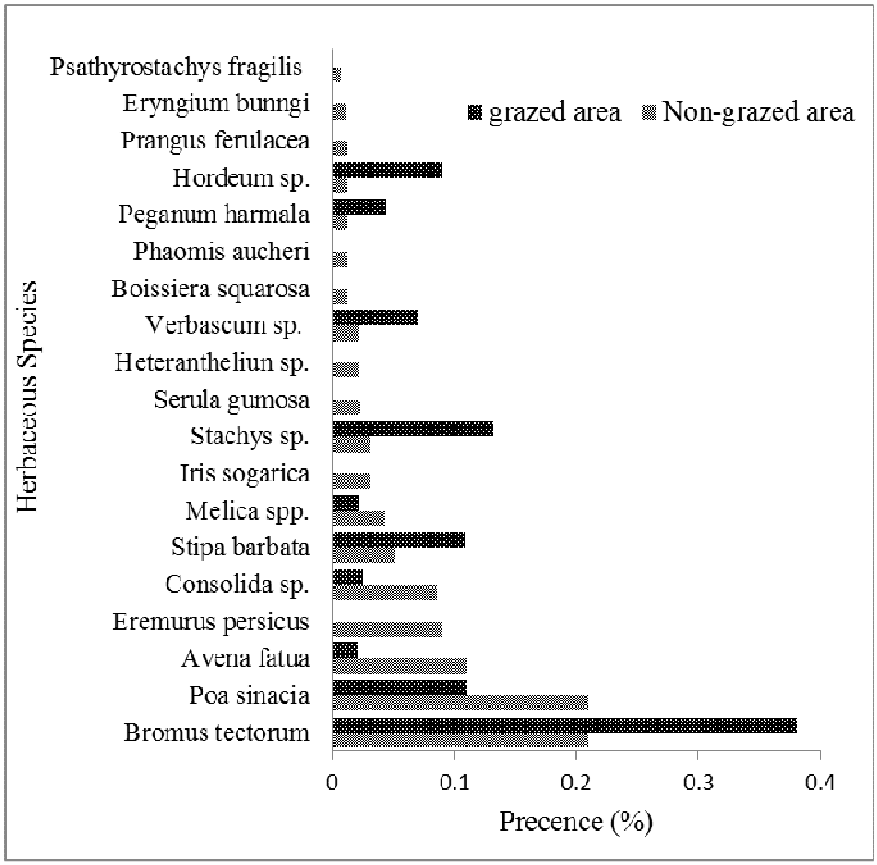

Figure 6. Comparison of herbaceous species Percent in the two grazed and non-grazed area

Results of Figure 6 showed 19 and 10 Shrub species observed in the non-grazed and grazed area. *Bromus tectorum* and *Poa sinacia* were the most dominant herbaceous plants in this area.

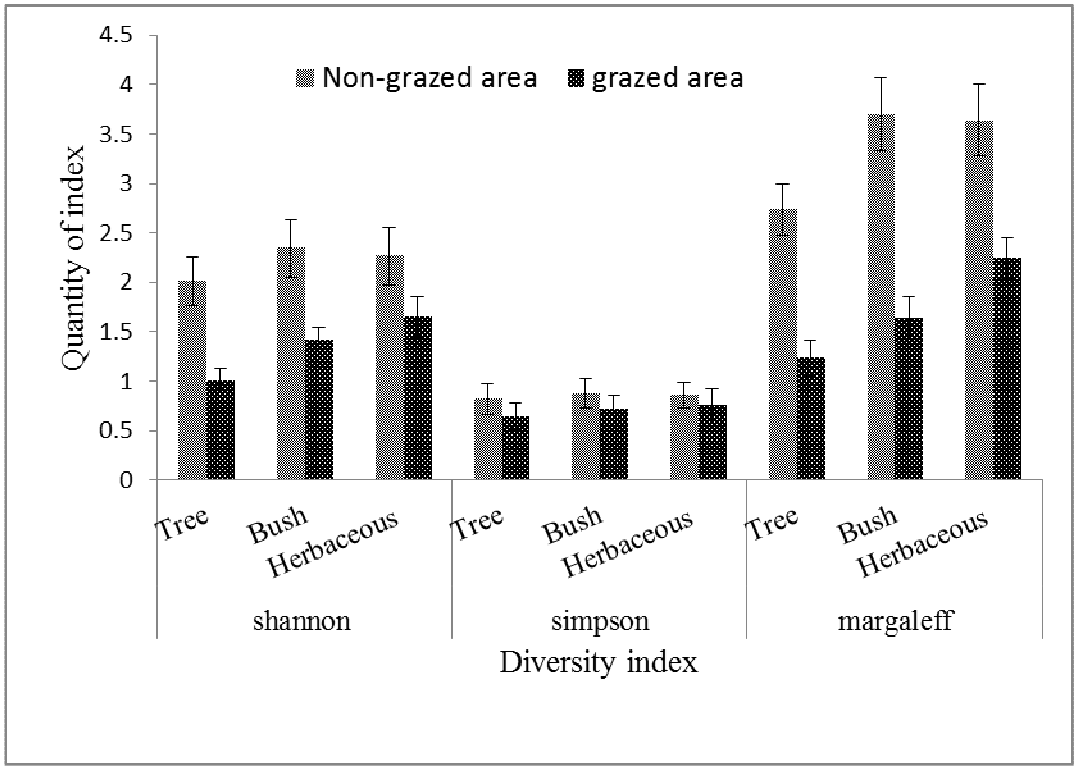

Figure 7.Mean diversity indices in grazed and non-grazed area in tree, shrub and herbaceous layer.

The results of Figure 7 showed that the computed tree species diversity index is as follows: mean species Shannon index: 2.01and 1.05, Simpson index: 0.81 and 0.64, Margaleff index: 2.73 and 1.23; Shrub species diversity index is as follows: mean species Shannon index: 2.34and 1.42, Simpson index: 0.88 and 0.72, Margaleff index: 3.7 and 1.64 and herbaceous species diversity index is as follows: mean species Shannon index: 2.26and 1.64, Simpson index: 0.85 and 0.75, Margaleff index: 3.63 and 2.24 in non-grazed and grazed area. Result table 3 indicated the differences between tree, shrub and herbaceous diversity indexes in the two regions were statistically significant.

Table 3.The results of t-test to analysis to compered the means biodiversity index in two areas

Vegetation layers	Diversity index	DF	F	Sig.
Tree layer	Shannon	59	6612.95	0.000
	Simpson	59	479.65	0.000
	Margaleff	59	6495.99	0.000
Shrub Layer	Shannon	59	2805.80	0.000
	Simpson	59	318.99	0.000
	Margaleff	59	6876.91	0.000
herbaceous layer	Shannon	59	6982.01	0.000
	Simpson	59	521.16	0.000
	Margaleff	59	7002.03	0.000

Discussion

Calculation and comparison of different indices of diversity, as a favorite method is considered for study on biodiversity (5). The assessment of biodiversity in forest has become an important issue for studying ecosystems and their conservation (4). Biodiversity measurement is recognized as guidance for conservation plans in local scale. Species biodiversity is used greatly in vegetation studies, and environmental evaluation is one of the main criteria to determine ecosystems condition (18). All three calculated indices in this study have been mentioned as the most applicable indices (5, 19). The Iran-o-Turanian zone in areas where enough rain falls to support habitation, humans have degraded the landscape. Agriculture, pastoralism, and woodcutting have caused the loss of natural vegetation. One of the serious threats to most of the Iranian ecosystems is drought, because much of Iran lies in the arid or semi-arid regions. The other threats for plants are: overgrazing, fuel wood extraction, conversion of forest and other wild lands for agriculture, road construction, overexploitation, and unscientific extraction of plant resources for medicine, food. Different researches paid attention to Comparison of plant diversity in two protected and non-protected area (Abasi et al, 2009; Gholami et al, 2007). The presence of 55 plant species in 120 ha area indicates considerable plant diversity in the study area. Our results showed that herb layer had the highest diversity indices (richness, diversity and evenness) (table 2). The diameters dispersion in the grazed area showed the lowest regeneration in lowest diameter class (5, 10 and 15 cm) and result showed the negative impact of grazing on the regeneration but in the non-grazing area have highest number of regeneration (number per hectare) and in lowest diameter class (5, 10 and 15 cm) have maximum of regeneration (Figure 3). The tree layer in non-grazed area was interpreted. 28% of the tree was *Pistacia atlantica*, 15% of them were *Pistacia khinjuk*, 19% was *Amygdalus communis*, 15% Amygdalus scoparia, 11% Acer monspessulanum and other 11 species was 24%. The tree layer in grazed area was interpreted. 46% of the tree was *Pistacia atlantica*, 5% of them were *Pistacia khinjuk*, 35% was *Amygdalus communis*, 7% *Acer monspessulanum* and *Crataegus* sp. was 5%.result showed the number of species in the non-grazed area was more the grazed area (Figure 4). The Bush layer in non-grazed area was interpreted. 22% of the species was *Acantholimon* Sp., 18% of them were *Astragalus* spp, 11% was *Polygonum* sp., 8% *Picris strigosa*, 7% *Silene* sp and other 14 species was 34%. The Bush layer in grazed area was interpreted. 44% of the species was *Acantholimon* sp, 25% of them were *Astragalus* sp., 17% was *Artemisia* sp., 9% *Acanthophylium caespitosum* Boiss and *Gallium* sp was 3%.result showed the number of species in the non-grazed area was more the grazed area (Figure 5). The Herbaceous layer in non-grazed area was interpreted. 21% of the species was *Bromus tectorum*, 21% of them were *Poa sinacia*, 11% was *Avena fatua*, 9% *Eremurus persicus*, 8.5% *Consolida* sp. and other 14 species was 29%. The Herbaceous layer in grazed area was interpreted. 38% of the species was *Bromus tectorum*, 13.2% of them were *Stachys* sp., 11% was *Poa sinacia*, 10.8% *Stipa barbata* and and other 6 species was 27%. Result showed the number of species in the non-grazed area was more the grazed area (Figure 6). Computed Shannon, Simpson and Margaleff index in the two area showed the highest mean diversity index were found in the non-grazed area (Figure 7). In the Bush layer Computed Shannon, Simpson and Margaleff index in the two areas showed the highest mean diversity index were found in the non-grazed area. Result compering the herbaceous layer showed the diversity index in non-grazing area was more the grazing area (Figure 7).result showed the different between the means diversity index in the two non-grazed and grazed areas were statistically significant and protection lead to increase the tree, Bush and herbaceous diversity (table 3). Many studies have emphasized the effects of grazing and human utilization on plant diversity. Result showed that high plant diversity in our study area was in the protection condition (non-grazed). Abasi et al (2009) showed that that trees and shrubs living in the protected regions species

have significantly higher diversity, richness, evenness and better living condition than they living in non-protected region and it was the tree, shrub and herbaceous diversity layer due to high diversity and number of species in the non-grazed area in the study area. Gholami et al (2007) showed that highest value in Shannon-Wiener index was in the protected area and in our study plant diversity in non-grazed area (protected area) was more the grazed area.

CONCLUSION

Grazing is a global, dominant land use covering more than 25% of the terrestrial surface of the globe and a larger geographic area than any other land use (2). Grazing affects plant communities and associated fauna, with implications for biodiversity and ecosystem processes (12, 21). Result showed that livestock grazing could be the principal factor of the poor regeneration in the study area and in the grazed area have lowest regeneration. Results indicated the complete protection (non-grazed) area have higher plant diversity compered the grazed region and grazing have a negative impact on the plant diversity. Therefore, prevention of livestock grazing and irregular tree cutting in the degraded forest stands can be suggested as a suitable approach for natural restoration and increasing plant diversity.

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