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Effect of Conservation on Plant Species Diversity, Kurdistan, Western Iran

Hassan Pourbabaei* and Verya Rahimi
Department of Forestry, Faculty of Natural Resources, University of Guilan, Sowmehsara, Guilan, Iran

Abstract

This study was carried out in the Boin and Miryousef regions in Baneh of Kordestan province, west of Iran. Both areas were divided into two parts including protected and unprotected areas. In each area, 20 1000-m^2circular plots were established following a selective method. Tree and shrub species were identified and the number of these species was counted in each sampling plot. The results indicated that 7 trees, 4 shrubs and 109 herbaceous species were found in the studied areas, 40 herbaceous, 7 tree and 3 shrub species were present in protected area, while unprotected area had 16 herbaceous and 3 tree species. The highest value of diversity indices belonged to protected areas in all vegetation layers. In tree layer, *Quercus brantii* had the greatest value of SIV, whereas the lowest value belonged to *Pistacia atlantica*. In shrub layer, the highest and lowest values of SIV belonged to *Daphne mezereum* and *Cerasus microcarpa*, respectively. Finally, in herbaceous layer, *Luzula spicata* had highest value of SIV, and lowest value was belonged to *Galium* sp.

Key Words: diversity, kurdistan province, plant species, protected area, richness

Introduction

Conservation of biodiversity has been considered as a management objective in past decade (Jonathan and Nicole 2005) and is a major task for forest manager if ecological integration be a main part in forest ecosystems (Christense and Emborg 1996). The forests are dynamic mosaic with different ages that are affected by biotic and abiotic factors. Development and evolution of forest in the world had a close relationship with the history of human communities (Onadiana et al. 2004). Overall, there is a negative correlation between human activities and plant cover. According to scientifically controversial concept of the "balance of nature, biological diversity can be seen as a general indicator for ecosystem stability and ecological resilience" (Chumak et al. 2005). Biological diversity among living organisms is variety and has five main components including: genetic, species, community, landscape and process or functions (Hunter 1996) that are important to maintain for achieving to sustainable development (Kaya and Raynal 2001).

The Convention of Biological Diversity (CBD) obliges signatory nations to undertake an inventory of their biological diversity to provide basic information about the distribution and abundance of biodiversity which are necessary for long-term sustainable management and conservation of biodiversity (Dallmeier and Alonso 2004). Understanding the relationship between diversity and land use history in forest ecosystems is an appropriate tool for decision in forest management, especially when these ecosystems were used widely by human. Environmental factors such as human

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Corresponding author: Hassan Pourbabaei
Department of Forestry, Faculty of Natural Resources, University of Guilan, Sowmehsara, P. O. Box 1144, Guilan, Iran
Tel: +981344323024, Fax: +981344323600, E-mail: hpourbabaei@gmail.com

uses has been considered as the main mechanism for degradation of forests. In the most forest areas in Iran, rural people are in close relationship by natural resources, especially forests (Reyers 2004). This factor is the most important for dynamics and sustainability of forest ecosystems.

Sustainable management of natural resources is important in Iran. In recent years, economic value of Iran's forests have declined, whereas environmental and social importances of these forests have increased (Gorji Bahri 2000). Forest areas of Iran are estimated 12 million ha which covered nearly 7.3% of Iran's area (Marvi Mohajer 2005). The Zagros forests extend in the west of Iran and covered an area of 5.05 million ha and have mostly open canopy (Jazirei and Rastaghi 2003). These forests have main influence on water supply, soil conservation, climate alternation and socio- economical balance of entire country (Sageb-Talebi et al. 2004). Zagros forests have been divided into two distinct regions based on the different oak species including northern and southern Zagros (Sageb Talebi et al. 2004; Ghazanfari et al. 2004). Northern Zagros is more humid and colder than southern and has been dominated by *Quercus infectoria* which is mixed with *Q. libani, Q. brantii* or both of them. However, southern Zagros is the exclusive site for *Q. brantii* (Pourbabaei and Zandi Navgaran 2011; Bazyar et al. 2013). These forests are in critical situation and likely to reach a stage of destruction and some studies indicated that many species in these forests are rare and many of them are endangered (Al Yassin 2002; Jazirei and Rastaghi 2003). In recent years, research about biodiversity in managed ecosystems has increased due to species declines and habitat loss. Considerable studies such as Buncina (2000), Chumak et al. (2005), Pourbabaei and Zandi Navgaran (2011), Pourbabaei et al. (2014) show the effects of conservation on plant species diversity, composition and community structure.

Destruction factors including presence of livestock, dairy farmers and local people in Zagros forests are dominant and associated with ecological values of these forests. In addition, forest protection and development is not possible without considering these issues, therefore, study and obtaining information and knowledge about these ecosystems are necessary for appropriate management and methods of reconstruction. Therefore, this study was done to assess the effect of disturbance on plant diversity in Zagros forests. The results of this study can be valuable for managers to estimate trend of Zagros forests disturbance, make decisions about the protection of these ecosystems in order to help to conservation of plant diversity.

Materials and Methods

Study area

This Study was carried out in the Boin and Miryousef regions in Baneh of Kurdistan province, west of Iran. Both

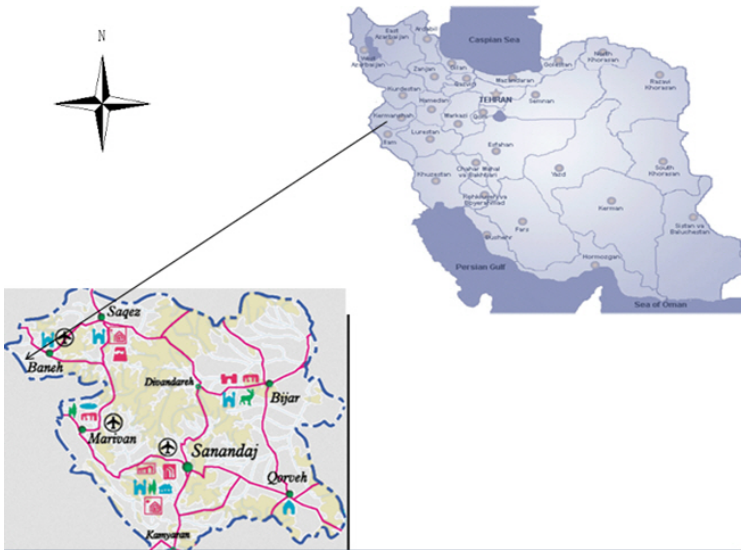

Fig. 1. The study area and its location on the map.

areas were divided into two parts i.e., protected and unprotected. The protected area of Boin covers 3 ha, and latitude is 35° 57' 49" N" and longitude is 46° 00 53" E (Fig. 1). Elevation varies from 1628 to 1672 m a.s.l. and the area is mainly characterized by southern and southeastern aspects. The unprotected stand covers 3.2 ha (35° 57' 48" N; 46° 00 53" E) and elevation varies from 1620 to 1673 m a.s.l. and largely dominated by eastern aspect. The protected area of Miryousef covers 2.9 ha (35° 55' 40" N; 45° 45' 19" E), and elevation varies from 1537 to 1569 m a.s.l. The unprotected area of Miryousef covers 3.1 ha (35° 55' 42" N; 45° 45' 21" E), and elevation varies from 1542 to 1570 m a.s.l. In addition, common forest soils are acidic with a pH varying between 5.5 and 6.5. The climate is characterized by cool, wet winters and warm, and dry summers. Mean annual precipitation and temperature are 658.28 mm and 13.67°C, respectively. Dairy farmers and local people are living in the area during the year. These forests are under pressure of heavy grazing livestock, girdling, excessive cutting of trees and shrubs to supply fuel wood.

Data collection

At the first, the protected and unprotected areas in each region were selected. Then, 20 1000-m^2 circular plots were established following a selective method in each area (Zobeiri 2006). Elevation, aspect, slope percentage, crown canopy percentage were recorded at each sampling plot. Tree and shrub species were identified and the number of each species was counted. In addition, diameter at breast height (DBH) of trees more than 5 cm was measured (Pourbabaei et al. 2014) and litter depth was measured at five locations within each plot (Pourbabaei et al. 2014). In herbaceous layer, Whittaker's nested plot sampling and minimal area methods were used to determine plots size. This resulted in subplots of 256 m^2 being sampled for herbaceous species measurements and percentage cover of each species was estimated according to the Domincriterion (Mueller-Dombois and Ellenberg 1989).

Data analysis

Diversity indices including Simpson, Shannon-Wiener, Hill's and MacArthur, evenness such as Smith and Wilson's index and richness were calculated for tree and shrub layers in all the 1000-m^2 plots (Krebs 1989). Diversity indices were computed using Ecological Methodology software for Windows, version 6.0. Ultimately, Species Important Values (SIV) was determined for tree, shrub and herbaceous layers and calculated as the following three formulae (Adam et al. 2007):

$$\text{Relative density} = \frac{\text{Number of each speices}}{\text{Total number of species}} \times 100 \quad (1)$$

$$\text{Relative dominance (tree layer)} = \frac{\text{Basal area of each species}}{\text{Total basal area}} \times 100 \quad (2)$$

$$\text{Relative dominance (herbaceous layer)} = \frac{\text{Total cover percentage of each species}}{\text{Cover percentage of all species}} \times 100 \quad (3)$$

$$\text{Relative frequency} = \frac{\text{Number of plots for each species}}{\text{Total number of plots}} \times 100 \quad (4)$$

For the tree layer, the SIV was calculated as the summation of relative density, relative dominance and relative frequency, whereas for the shrub layer, it was equal to the summation of the relative density and the relative frequency. In herbaceous layer, it was calculated through summation the relative dominance and relative frequency.

Results

The results indicated that 109 species belonging to 7 tree species, 4 shrub species and 98 herbaceous species were identified in the studied areas. 7 tree species were present in the Boin and Miryousef protected areas. 4 shrub species were found in protected areas, but there was no shrub species in the unprotected areas. In herbaceous layer, 21 and 10 species were found in the protected and unprotected of Boin areas, respectively. Whereas, 17 and 6 herbaceous species were identified in protected and unprotected of Miryousef areas, respectively. Finally, 44 species were common among protected and unprotected areas of two regions. The list of species provided in Table 1.

The study of diversity indices in Boin and Miryousef regions indicated that the mean diversity in woody plants

Table 1. List of trees, shrubs and herbaceous species in the protected and unprotected areas of Boin and Miryousef

Species	Family	Life form	Boin		Miryousef	
			P	Up	P	Up
Acer monspessulanum	Aceraceae	Tree	*	*	*	*
Crataegus pontica	Rosaceae	Tree	*	*	*	*
Pistacia atlantica	Anacardiaceae	Tree	*	*	*	*
Pyrus syriaca	Rosaceae	Tree	*	*	*	*
Quercus brantii	Fagaceae	Tree	*	*	*	*
Quercus infectoria	Fagaceae	Tree	*	*	*	*
Quercus libani	Fagaceae	Tree	*	*	*	*
Amygdalus lycioides sp	Rosacea	Shrub	*	-	*	-
Cerasus microcarpa	Rosacea	Shrub	*	-	*	-
Daphne caucasica.	Thymelaceae	Shrub	*	-	*	-
Lonicera nummularifolia	Caprifoliaceae	Shrub	*	-	*	-
Achillea filipendula	Asteraceae	Herb	*	-	-	-
Codonocephalum peacokianum.	Asteraceae	Herb	*	-	-	-
Chaerophyllum	Apiaceae	Herb	*	-	-	-
Echium italicum	Boraginaceae	Herb	*	-	-	-
Salvia nemrosa	Lamiaceae	Herb	*	-	-	-
Scariola orientalis	Asteraceae	Herb	*	-	-	-
Scutellaria pinnatifida	Lamiaceae	Herb	*	-	-	-
Melandrium persicum	Caryophyllaceae	Herb	*	-	-	-
Myosotis olympica	Boraginaceae	Herb	*	-	-	-
Muscari caucasicum	Liliaceae	Herb	*	-	-	-
Pimpinella sakifraya	Apiaceae	Herb	*	-	-	-
Potentilla persica	Rosaceae	Herb	*	-	-	-
Ophrys reinhaldii	Orchidaceae	Herb	*	-	-	-
Inula britannica	Asteraceae	Herb	*	-	-	-
Ixiolirion tataricum	Amaryllidaceae	Herb	*	-	-	-
Taraxacum syriacum s	Asteraceae	Herb	*	-	-	-
Tragopogon graminifolius	Asteraceae	Herb	*	-	-	-
Vicia variabilis.	Fabaceae	Herb	*	-	-	-
Vicia villosa	Fabaceae	Herb	*	-	-	-
Xeranthemum inaepertum.	Asteraceae	Herb	*	-	-	-
Zoegea leptaurea	Asteraceae	Herb	*	-	-	-
Achilea milifolium	Asteraceae	Herb	-	*	-	-
Achiua milifoliw	Asteraceae	Herb	-	*	-	-
Bromus tecterum	Poaceae	Herb	-	*	-	-
Centaurea bruguierana	Asteraceae	Herb	-	*	-	-
Silen inflate	Caryophyllaceae	Herb	-	*	-	-
Lotus tenuifolius	Fabaceae	Herb	-	*	-	-
Londosia sp	Chenopodiaceae	Herb	-	*	-	-
Tanacetum persica	Asteraceae	Herb	-	*	-	-
Teucrium polium	Lamiaceae	Herb	-	*	-	-
Trifolium campestre	Fabaceae	Herb	-	*	-	-
Astragalus curvirstris.	Fabaceae	Herb	-	-	*	-
Astragalus sp	Fabaceae	Herb	-	-	*	-
Centaurea virgata	Asteraceae	Herb	-	-	*	-
Echinops mossulensis.	Asteraceae	Herb	-	-	*	-
Euphorbia sp.	Euphorbiaceae	Herb	-	-	*	-

Table 1. Continued

Species	Family	Life form	Boin		Miryousef	
			P	Up	P	Up
Gladiolus segetum	Iridaceae	Herb	-	-	*	-
Hypericum Sp	Hypericaceae	Herb	-	-	*	-
Lamium album.	Lamiaceae	Herb	-	-	*	-
Rhabdoscidium aucheri.	Apiaceae	Herb	-	-	*	-
Scabiosa leucactis	Dipsacaceae	Herb	-	-	*	-
Scutellaria pinnatifida.	Lamiaceae	Herb	-	-	*	-
Serratula grandifolia.	Asteraceae	Herb	-	-	*	-
Symphytum kurdicum	Boraginaceae	Herb	-	-	*	-
Papaver rhoeas	Papaveraceae	Herb	-	-	*	-
Trifolium dasyurum.	Fabaceae	Herb	-	-	*	-
Turginia latifolia	Apiaceae	Herb	-	-	*	-
myosuroides.	Gramineae	Herb	-	-	-	*
Burgardia sp.	Berberidaceae	Herb	-	-	-	*
Calepeltis cucularia	Berberidaceae	Herb	-	-	-	*
Centaurea solstitialis	Asteraceae	Herb	-	-	-	*
Lotus temuifolius	Fabaceae	Herb	-	-	-	*
ficaria kochyi	Ranunculaceae	Herb	-	-	-	*
Achilea milifolia	Asteraceae	Herb	*	-	*	-
Bellevalia longistyla	Liliaceae	Herb	*	-	*	-
Brassi cecacea	Brassicecacea	Herb	*	-	*	-
Euphorbia sequieriana.	Euphorbiaceae	Herb	*	-	*	-
Galiumso sp	Rubiaceae	Herb	*	-	*	-
Vicia variabilis	Fabaceae	Herb	*	-	*	-
Burgardia sp.	Berberidaceae	Herb	-	*	-	*
Luzula spicata	Juncaceae	Herb	-	*	-	*
Aegilops triunialis	Fabaceae	Herb	*	*	*	*
Astragalus sp	Fabaceae	Herb	*	*	*	*
Astragalus parrowianus	Fabaceae	Herb	*	*	*	*
Astragalus glauucops	Fabaceae	Herb	*	*	*	*
Asperula sp.	Rubiaceae	Herb	*	*	*	*
Alyssum sp	Brassicaceae	Herb	*	*	*	*
Bellevalia longistyla	Liliaceae	Herb	*	*	*	*
Bromus tectorum	Poaceae	Herb	*	*	*	*
Centaurea virgata	Asteraceae	Herb	*	*	*	*
Cerastium inflatum	Caryophyllaceae	Herb	*	*	*	*
Cephalavia dichaetophora	Asteraceae	Herb	*	*	*	*
Chrysanthemum parlhenium	Asteraceae	Herb	*	*	*	*
Chaerophyllum sp.	Apiaceae	Herb	*	*	*	*
Crepis sp.	Asteraceae	Herb	*	*	*	*
Dactylis glomerata	Poaceae	Herb	*	*	*	*
Echinops ritrodees	Asteraceae	Herb	*	*	*	*
Fumaria sp	Fumariaceae	Herb	*	*	*	*
Hypericum perforatum	Hypericaceae	Herb	*	*	*	*
Inula britannica	Asteraceae	Herb	*	*	*	*
Galium vernum.	Rubiaceae	Herb	*	*	*	*
Gundelia Tournefortii	Rubiaceae	Herb	*	*	*	*
Lamium sp.	Asteraceae	Herb	*	*	*	*

Table 1. Continued

Species	Family	Life form	Boin		Miryousef	
			P	Up	P	Up
Lathyrus nissolia	Lamiaceae	Herb	*	*	*	*
Potentilla recta	Fabaceae	Herb	*	*	*	*
Poa bulbosa	Rosaceae	Herb	*	*	*	*
Poa timoleontis	Poaceae	Herb	*	*	*	*
Picnomon acarna	Poaceae	Herb	*	*	*	*
Plantago sp.	Plantaginaceae	Herb	*	*	*	*
Phlomis oliveri	Lamiaceae	Herb	*	*	*	*
Prangos ferulaceae	Apiaceae	Herb	*	*	*	*
Pisum sativum	Fabaceae	Herb	*	*	*	*
Salvia bracteata	Lamiaceae	Herb	*	*	*	*
Stachys inflate	Lamiaceae	Herb	*	*	*	*
Scutellaria pinnatifida	Lamiaceae	Herb	*	*	*	*
Plantago sp.	Plantaginaceae	Herb	*	*	*	*
Phlomis oliveri	Lamiaceae	Herb	*	*	*	*
Prangos ferulaceae	Apiaceae	Herb	*	*	*	*
Pisum sativum	Fabaceae	Herb	*	*	*	*
Salvia bracteata	Lamiaceae	Herb	*	*	*	*
Stachys inflate	Lamiaceae	Herb	*	*	*	*
Scutellaria pinnatifida	Lamiaceae	Herb	*	*	*	*
Trifolium fragiferum	Fabaceae	Herb	*	*	*	*
Thlaspi sp.	Brassicaceae	Herb	*	*	*	*
Trifolium sp.	Fabaceae	Herb	*	*	*	*
T. ambigum	Fabaceae	Herb	*	*	*	*
Trifolium pilulare	Fabaceae	Herb	*	*	*	*
Tragopogon graminifolius	Asteraceae	Herb	*	*	*	*
Viola sp.	Violaceae	Herb	*	*	*	*
Vicia sp.	Fabaceae	Herb	*	*	*	*
Vicia variabilis	Fabaceae	Herb	*	*	*	*

*Indicate the present of species in studied areas.

layer was higher in protected than unprotected areas (Fig. 2). The mean richness was greater in the protected areas; however, evenness indices were higher in the unprotected than protected areas (Fig. 3). In herbaceous layer, the mean diversity and richness indices were higher in the protected than unprotected areas (Fig. 4, 5), whereas, the mean evenness was higher in unprotected than protected in Miryousef region (Fig. 5).

The results of SIV in protected area of Boin showed that the highest value of it belonged to *Q. brantii* and the lowest belonged to *P. atlantica* (Fig. 6), whereas, in unprotected area *Crataegus pontica* had lowest of SIV (Fig. 7). In Miryousef region, *Q. brantii* had highest value of SIV in protected and unprotected areas (Fig. 8, 9). According to results, shrub species were present in protected areas including *Amygdalus lycioides, C.microcarpa, Daphne caucasica* and *Lonicera nummularifolia. Daphne caucasica* had highest value of SIV in Boin and Miryousef regions, while, the lowest SIV belonged to *C. microcarpa* (Fig. 10, 11).

In herbaceous layer, the highest value of SIV was found for *Cariola orientalis*, and *Tragopogon gereuminifolia* had lowest value of SIV in the protected area of Boin (Fig. 12), however, in the unprotected area, *Luzula spicata* and *Lathyrus nissolia* had highest and lowest of SIV, respectively (Fig. 13). In the Miryousef, *Galium* sp. had the highest value of SIV in protected, and greatest value of SIV in unprotected areas belonged to *Papaver rhoeas* (Fig. 14, 15). Finally, the curves associated with the protected areas showed higher

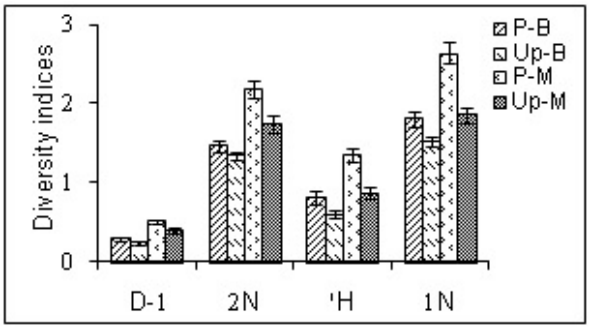

Fig. 2. Diversity indices (mean±standard error) of woody layer in studied areas (P-B: protected of Boin; Up-B: unprotected of Boin; P-M: protected of Miryousef; Up-M: unprotected of Miryousef).

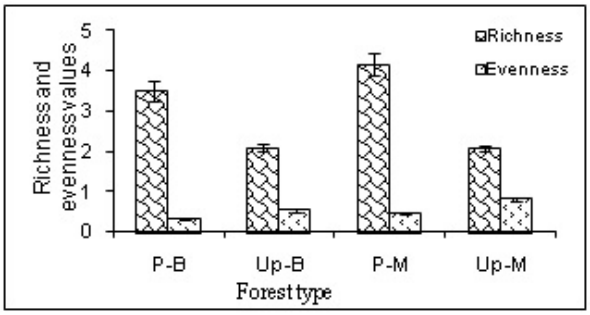

Fig. 3. The mean and standard error of richness and evenness indices of woody layer in studied areas.

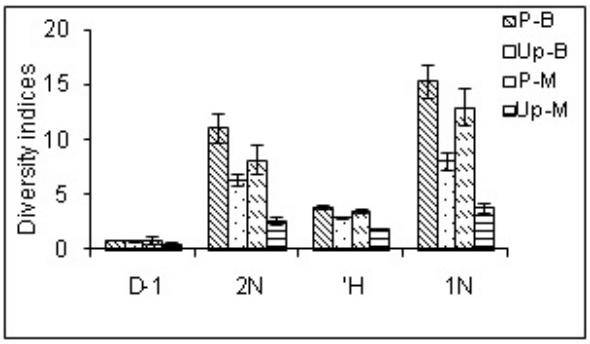

Fig. 4. Diversity indices (mean±standard error) of herbaceous layer in studied areas.

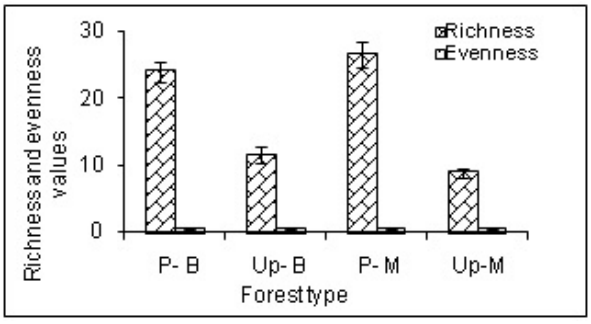

Fig. 5. The mean and standard error of richness and evenness indices of herbaceous layer in studied areas.

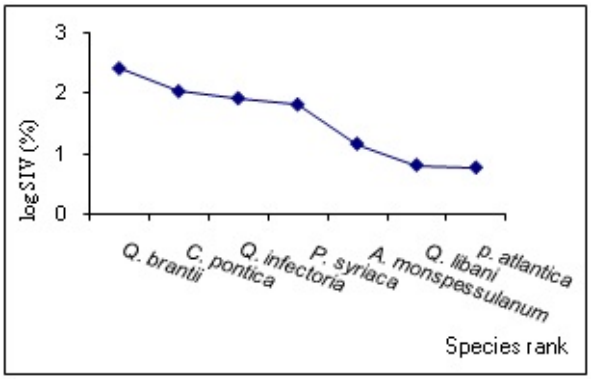

Fig. 6. SIV of tree species in the protected area of Boin.

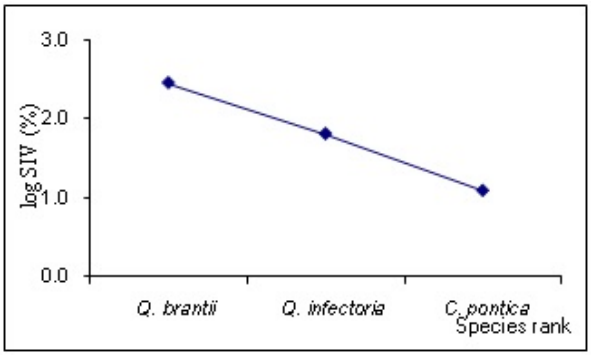

Fig. 7. SIV of tree species in the unprotected of Boin.

relative abundance and had a lower slope as compared to the unprotected areas.

Discussion

Zagros forests are substantial ecosystems with an area of 5.5 million ha and 818 plant species (Jazireie and Rastaghi 2003).The results indicated that 109 plant species were identified in the study areas. It shows high values of richness in these areas, that are contrasts with other studies including Zandi (2005) and Mirzaie (2005) with 85 and 90 plant species, respectively. According to our results, protected areas had the highest diversity in the both regions, whereas, the lowest value of diversity indices belonged to

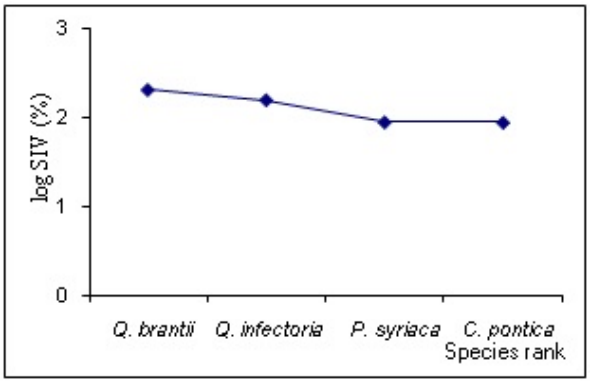

Fig. 8. SIV of tree species in the protected of Miryousef.

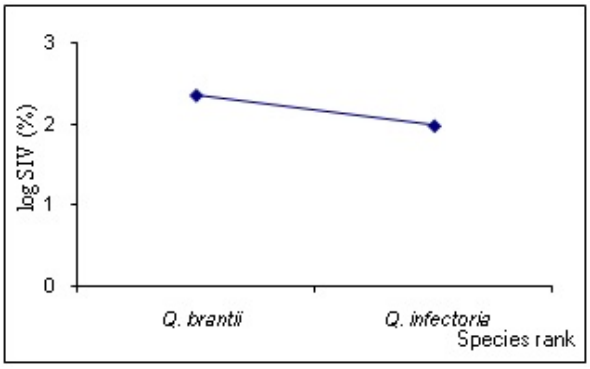

Fig. 9. SIV of tree species in the unprotected of Miryousef.

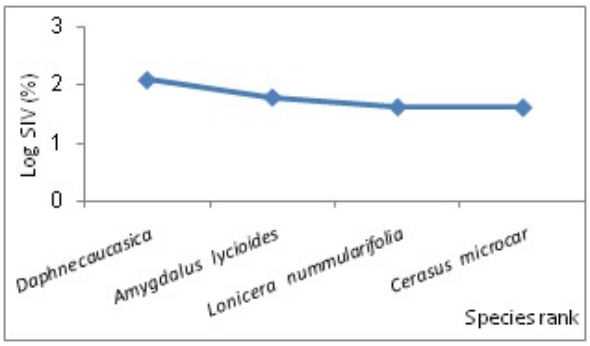

Fig. 10. SIV of shrub species in the Boin.

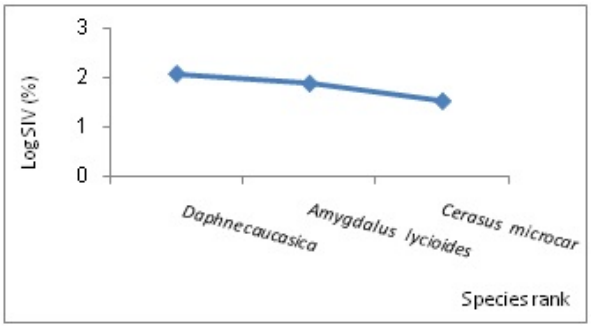

Fig. 11. SIV of shrub species in the Miryousef.

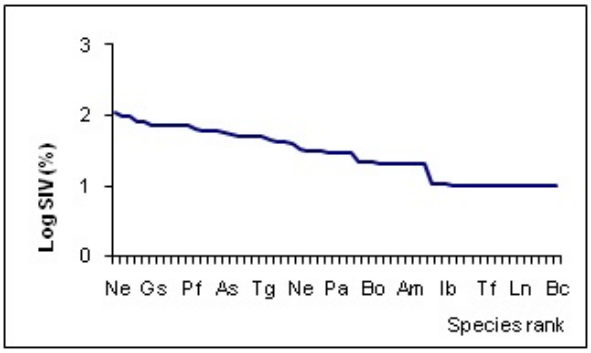

Fig. 12. SIV of herbaceous species in the protected area of Boin.

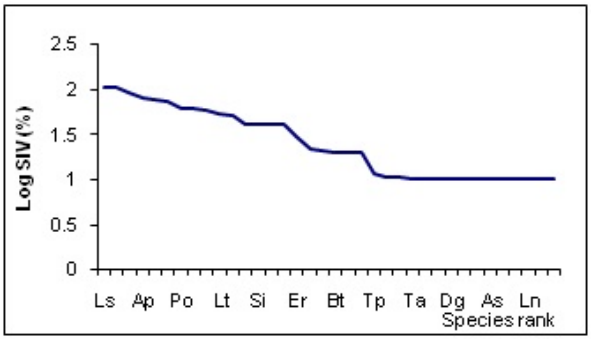

Fig. 13. SIV of herbaceous species in the in the unprotected area of Boin.

unprotected of Boin region. High density of livestock, continuous overgrazing and traditional utilization by local people in unprotected areas reduced productivity of them and changed the structure and species composition (Oztas et al. 2003; Clark and Covey 2012; Pourbabaei et al. 2014).

In woody layers, the mean of Simpson, Shannon- Wiener, N_2 and N_1 indices were higher in the protected area of Miryousef than Boin region. It's due to proximity of protected area of Miryousef to forests; while, the protected area of Boin is limited to agricultural land on the one side. Proximity or distance of forest stands can effect on species composition. Stands which are near to the forest have ecological stability and are closer to succession stages (Jazireie and Rastaghi 2003). Some studies indicated that diversity

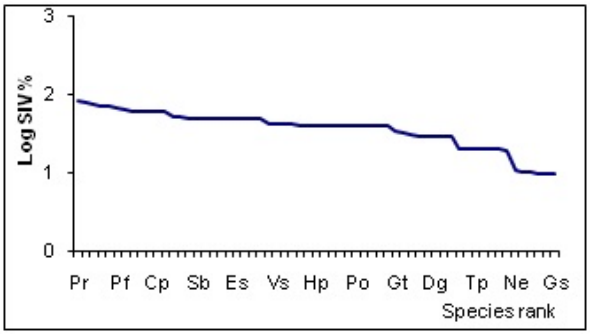

Fig. 14. SIV of herbaceous species in the protected area of Miryousef.

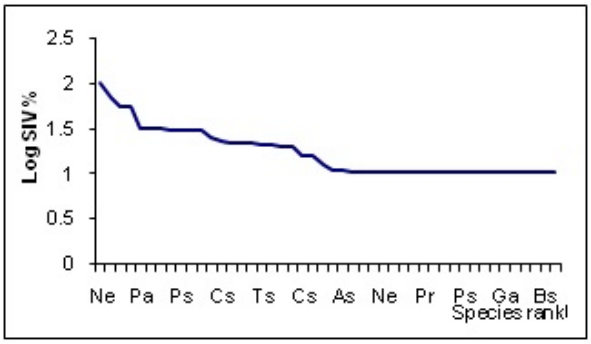

Fig. 15. SIV of herbaceous species in the unprotected area of Miryousef.

increased with distance from the villages, because of a general negative effect of human impact on alpha-diversity (Christensen and Heilmann-Clausen 2009). A major portion of people activities including agriculture and animal husbandry are in contrary to ecological potential of forest areas, these activities cause damage in short time and can affect survive of vegetation cover in long terms (Heydarpour Tutkale et al. 2008).

According to results, the unprotected areas had the lowest diversity and the species richness was decreased as already observed by Connell (1978), Vujnovic et al. (2002), Keeley et al. (2003), Bouahim et al. (2011), Krzic et al. (2003), Hendricks et al. (2005), Banda et al. (2006), Dorrough et al. (2007) and Cesa and Paruelo (2011). It should be noted that, in these areas, some species are selectively kept and other species have been removed. In addition, livestock grazing, intense harvesting of the foliage for livestock, collecting of oak seeds for preparation of flour, plowing of forest land have caused the greatest destruction (Chumak et al. 2005).

In the protected areas of Boin and Miryousef, the abundance distribution models of tree layer were followed of lognormal series. This means that most species have a moderate abundant and only very few species are abundant or very rare. Generally, we can say that these sites have high species diversity and plant species are lived together without competition (Magurran 2003). However, the unprotected areas had the lowest value of SIV, and abundance distribution models were followed of geometric series. This model confirms a community of a degraded environment in the early stages of succession with low diversity. The destructive conditions in these areas have been prevented of optimal species growth which led to increase dominant species density and decrease density of rare species. Abundance distribution of species was followed of broken stick model in the shrub layer. This model indicates homogeneous community with equal abundance, uniform distribution and low species richness (Magurran 2003). Finally, abundance distribution of herbaceous species followed of lognormal series in the both regions. The slope of the rank-abundance curve was less pronounced and more homogeneous in the protected area than in the unprotected area, a situation generally obtained when species abundance is changed uniformly.

Conclusion

Forest ecosystems has used in various ways by local people. Consecutive grazing and disturbance of human activities have created considerable negative effects on ecological processes. The overall results indicated that diversity in woody layer was increased using conservation. On the other hand, grazing and human disturbances were effective on the quality and quantity of forest in unprotected areas and have affected abundance and diversity of species. Hence, control of grazing in areas where have not been well managed can increase the diversity of native species. Protections of ecosystems against disturbances are important in order to identify the potential of these areas for effective management of biodiversity resources with providing services for local people.

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