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Effect of Ecotourism on Plant Biodiversity in Cherlagh Protected Area North-Eastern Iran

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Abstract. Due to importance of considerable effects of ecotourism on environment, the effect of ecotourism on plant biodiversity in Cherlagh zone was investigated .To acquire the aim of the article, the sampling area was selected under the condition that the ecotourism is solely the variable factor and the slope, direction and height are considered constant factor after evaluation of the ecological land unit drawings. Two zones of high pressured and low pressured ecotourism were considered after evaluation of related drawings. Samples were taken in spring 2010. For evaluation of the plant biodiversity 60 samples of 1 m^2 (30 samples in each zone) were taken randomly and then the list of flora and the cover percentage of vegetation were recorded and then the percentage of vegetation data were analyzed in PAST software individual , the biodiversity (Shanon, Simpson) richness (Menhinick, Margalef) evenness (Dominance, Berger parker,) indices were calculated. The mentioned indices were inserted in SPSS II software and the data normality was tested through Kolomogrov-Smirnov test also the homogeneity of variances was tested using Leven test. Due to data normality, non-paired T test was used in order to compare diversity analysis. The results indicate that the richness and individual indices show significant effects of ecotourism on biodiversity indices.

Key words: Ecotourism, Biodiversity, Evenness, Dominance, Richness.

Introduction

Protected Areas (PA) are the cornerstone for conserving mostimportant biodiversity in the face of rapid environmental change (PAUDEL & HEINEN, 2015). Ecotourism is a relatively new idea and hasemerged in the late 1980s that has dramatically capturedthe attention of many people from a variety of backgrounds (ESHETU, 2014).

Nowadays, many of ecotourism planning is done in a way that will damage the environmental sustainability. Sustainable ecotourism planning must aim to help and preserve nature, without altering tourists' basic mission to explore and unique status of ecotourism in the global environmental scheme (MIRSANJARI, 2012).

Many efforts have been conducted to determine the benefits of visitors who visit recreation areas of forest and national parks (AMIRNEJAD & KHALILIAN, 2006). Although there tends to be limited tourism infrastructure within protected areas there are often tracks, trails, roads, lookouts, fixed campsites, car parks and sometimes visitor

centers and accommodation. Although the total area allocated to infrastructure may be relatively small compared to the total area of the park, the impacts at that site are severe and often permanent (SMITH & NEWSOME, 2002; PICKERING & BUCKLEY, 2003; TURTON, 2005). The most obvious and direct impact is vegetation clearance, however, damage is not restricted to the initial removal of native vegetation, there are usually indirect effects in adjacent natural vegetation (SUN & WALSH, 1998). A common problem is that increasing visitor use can result in incremental hardening of sites with a gradual change from a natural to an urbanized environment (BUCKLEY & PANNELL, 1990). In addition, there may be displacement of park users and/or changes in the expectations of tourists, with those participating in mass tourism often requiring more sophisticated facilities, than those engaging in nature or adventure tourism (PICKERING & HILL, 2007). Review studies in Iran show that there are few studies on the estimation of recreation value of parks. For management of parks' assets to be effective and successful, it is necessary to obtain information about visitors' characteristics as well as their opinions. Ecotourism, as nature-based tourism with its special characteristics, is also considered as the impetus and economic investment for management of natural resources. To promote proper planning in this field, the current research uses data mining from the recreation values of Iran's parks, rate of WTP, amount of WTP, and separating influential factors on visitors' rate of WTP and amount. This knowledge then allows managers to manage parks accordingly. It can be effective in foreseeing the needs, eliminating the shortages, and developing the tourism in the parks. Iran has a long history of nature protection (KOLAHI *et al.*, 2013). Currently, PAs are divided into four categories under the management of Iran's Department of the Environment (DOE). However, since the 1950s, following new definitions of PAs, the number of PAs in Iran has increased dramatically, especially during the last 10 years. In total, 253 PAs have been declared which cover 10.12 % of the country's area (see Table 1).

Table 1. Protected and other natural areas in Iran (after KOLAHI *et al.*, 2013).

Categories	Number	Area (Ha)	% to the whole PAs	% to the country
National Parks	26	1960537	11.76	1.19
National Natural Monument	35	38697	0.23	0.02
Wildlife Refuge	42	5567643	33.39	3.38
Protected Area	150	9109857	54.63	5.53
Total	253	16676734	100	10.12

This article aims to contribute to the discussion on tourism in relation to biodiversity. It evaluates the effects of ecotourism on plant biodiversity by comparing the diversity, richness, dominance and evenness indices in two high-pressured and low-pressured zones and consequently presents the environmental management strategies for better conservation.

Materials and Methods

Site characteristics. "Tandoureh" National Park (37.19 N to 37.33 N; 58.33 E to 58.54 E), encompassing an area of approximately 4448 ha, is located 30 kilometers southwest of the Daregaz Region in Khorasan Razavi Province and close to the Turkmenistan border (Fig. 1). This park has significant heights, deep valleys and have mountainous climate. There are rare species of animals and plants in this park thus making it one of the most important wildlife areas nationally and internationally. Some of the important wild hosts for adult ticks in the park are wild sheep and goats, leopards, wild cats, wolves, jackals, foxes, rabbits and wild boars.

Most rain falls in winter and spring, comprising between 72% and 76% of all the annual rainfall. Fluctuations in annual temperature are large. Mean annual temperature is about 14.3°C, and warmest month of the year is July with a mean temperature of about 34.1°C and the coldest month January with a mean temperature of about 2.7°C. In Fig. 2, the sampling area has been depicted.

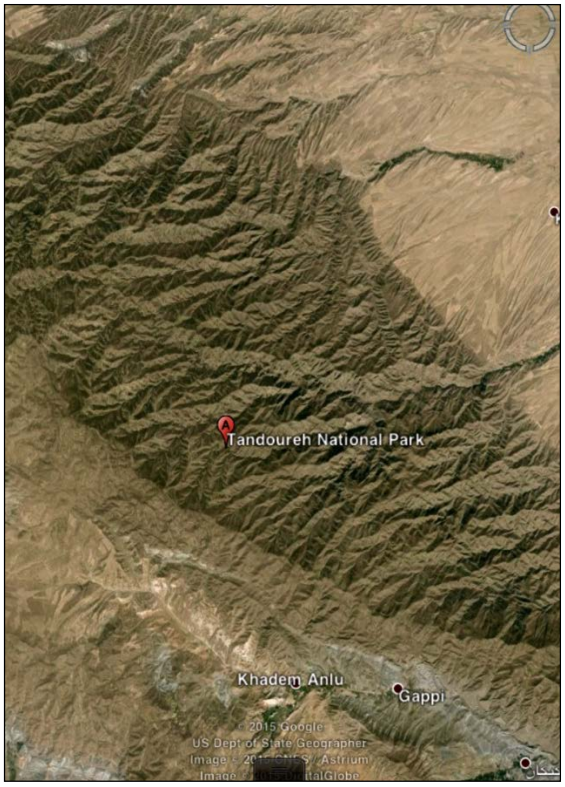

Fig. 1. Situation Map of the study area.

For evaluation of the plant biodiversity 60 samples of 1 m² (30 samples in each zone) were taken randomly and then the list of flora and the cover percentage of vegetation were recorded and then the percentage of vegetation data were analyzed in Biopast software and the biodiversity (Shanon, Simpson) richness (Menhinick, Margalef) evenness (Dominance, Bergerparker,) indices were calculated.

Fig. 2. A feature of the study area

Data analysis. The mentioned indices were inserted in SPSS II software and the data normality was tested through Kolomogrov-Smirnov test. Due to data normality, non-paired T test was used in order to compare diversity analysis. The indices which have been evaluated in this paper have been indicated in table 2. As it has been presented, individual, the biodiversity (Shanon, Simpson), richness (Menhinick, Margalef) evenness (Dominance, Bergerparker,) indices were calculated in this study and the formulas have been presented in Table 2.

Table 2. Diversity Indices evaluated in PAST software.

Index	Reference	Formula
Shanon	PEET (1974)	H` = -ΣI PIln (PI)
Simpson	HILL (1973)	N2= (ΣIPI2)-1
Margalef	MARGALEF (1985)	Dmg = S-1/ln (N)
Manhenick	MENHINICK (1964)	Dmn=S/√n
Berger-Parker	MAY (1975)	d = Nmax / N
Dominance	MAGURAN (1988)	1-Simpson index
Evenness	MAGURAN (1988)	eH/S
Equitability	MAGURAN (1988)	Shannon diversity divided by the logarithm of number of taxa

Results and Discussion

As it has been indicated in figures 3 to 5, richness and individual indices show significant effects of ecotourism on plant biodiversity. A and B in the results indicate that the diversity, and evenness indices don't show significant effects of ecotourism on biodiversity indices, but the richness and individual indices show significant effects of ecotourism on biodiversity indices. Table 3 also shows the floristic list of Cherlagh area.

There are no statistics about ecotourism in Iran. Mainly due to the lack of basic infrastructure, facilities and information, but in relation to this issue, few studies have been conducted in Mazandaran jungles and several of them have been performed in protected areas or national parks. In majority of the investigated zones have high species and richness diversity indices. Several protected areas and national and forest parks have an abundance of vegetation cover due to less anthropogenic factors, for instance MAHMODI *et al.* (2005) found 119 species in protected Kelarabad

forests, however the dominant species were *Alnus sp.*

There are many threats to vegetation in Iranian protected areas from tourism. Greater recognition needs to be given to this by protected area managers. Although the flora is internationally significant and protected area tourism is very popular there is still limited research on direct and indirect impacts of tourism for many Iranian plant communities. The species damage impacts are extremely vivid due to soil trampling, damage to flora, setting fire and building sports and playground which lead to low diversity, richness, and dominance and evenness indices in studied area. In this zone two factors of (i) existence of *Ailanthus altissima* species in high pressure zone (ii) anthropogenic factors decline all the biodiversity indices.

High diversity and richness indices in low-pressured zone compared to high-pressured zone were related to tourism effects. High evenness indices in high-pressured zone in related to invasive species growth against anthropogenic factors (HOSSEINI *et al.*, 2011). GOLEIJI (2011) came to the same conclusion that high pressure of tourism cause significant impacts on reduction of plant species, diversity, richness as well as increase of evenness. As a whole findings of this study show that high impacts of ecotourism cause significant impact on the decrease of plant species diversity and richness as well as increase of evenness in Tandoureh National Park so the management strategies should be considered by concerned authorities.

ZARGHI & HOSSEINI (2014) reached different conclusion in Chelmir zone of Tandoureh National Park which was divided in two high pressured zone and low pressured zone. The results indicate that the diversity, richness, dominance and evenness indices show significant effects of ecotourism on biodiversity indices. But in this study the results are considerably different and it indicates that the effect of ecotourism is more severe in Chelmir zone.

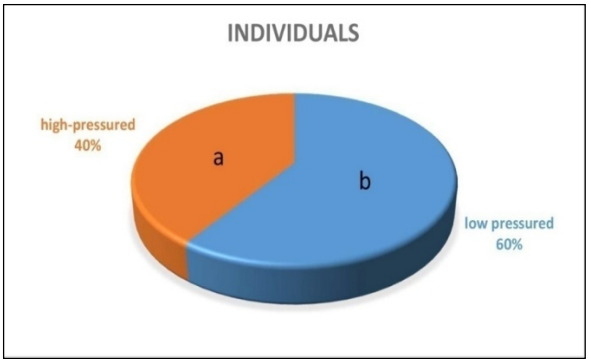

Fig. 3. Individual index show significant effects of ecotourism on biodiversity.

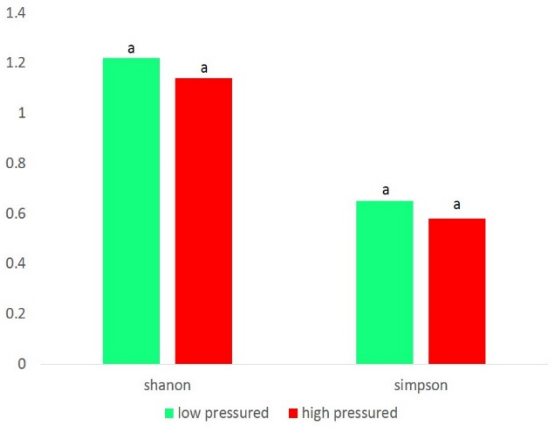

Fig 4. Biodiversity indices of plant biodiversity in low pressured and high pressured zones (explanations are in the text).

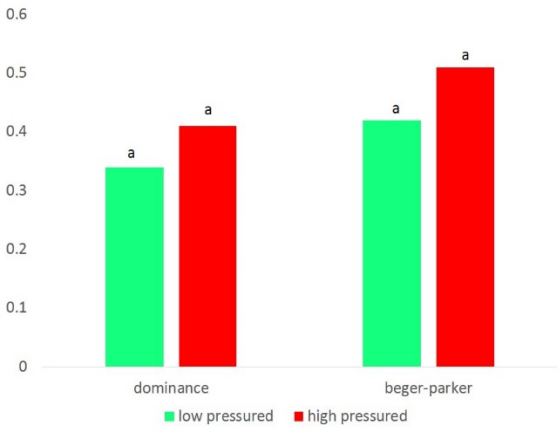

Fig. 5. Evenness indices of plant biodiversity in low pressured and high pressured zones (explanations are in the text).

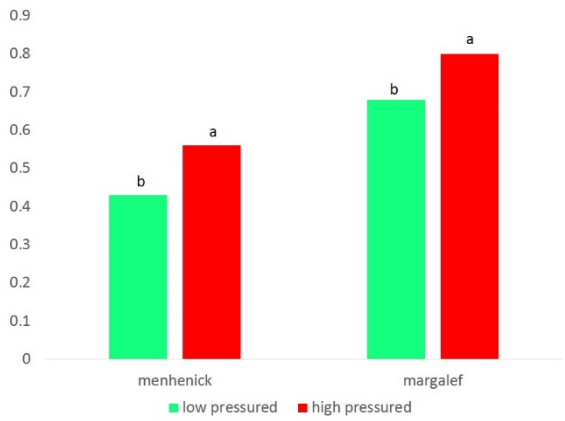

Fig. 6. Richness indices of plant biodiversity in low pressured and high pressured zones (explanations are in the text).

The ongoing decline in global biodiversity is largely attributed to human-induced impacts (MITCHELL *et al.*, 2015). Valuation park services, based on people's preferences can be useful to regulate the transfer of payments from beneficiaries to providers in return for maintaining the supply of the park services. Ecotourism potentially provides a sustainable approach to tourism development across the world. Visitors in PAs can generate both positive and negative environmental impacts (MCCOL, 2006). But some efforts show that through developing sustainable ecotourism it can be possible to change attitudes and increase conservation (e.g., BUCKLEY, 2012; HUSSAIN *et al.*, 2012; MILLER *et al.*, 2012).

Table 3. Floristic list of the recorded plant biodiversity in studied area.

Family	Scientific name	Forms	High-pressured zone	Low-pressured zone
Poaceae	*Poa bulbosa*	Geophyta-bulbosa	*	
Poaceae	*Hordium morinum*	Chamaephyta frutescenia	*	
Poaceae	*Stipa barbata*	Hemicripto Caespitosa		*
Poaceae	*Doctylis glomerata*	Hemicripto Caespitosa		*
Poaceae	*Brumus tomentullus*	Hemicripto Caespitosa		*
Cypraceae	*Carex stenophylla*	Geophyta rhizomatosa	*	
Fabaceae	*Onobrychis chorassanica*	Hemicripto Caespitosa		*
Fabaceae	*Medicago sativa*	Hemicripto Caespitosa		*
Fabaceae	*Astragalus bassernerri*	Hemicripto.Scaposa		*
Lamiaceae	*Phlomis cancellata*	Hemicripto Caespitosa	*	
Lamiaceae	*Hymenocrater botuminosus*	*Chamaephyta frutescenia*	*	
Papaveraceae	*Papaver pevenium*	Therophyta caespitosa		*
Papaveraceae	*Papaver decaisnei*	Therophyta caespitosa		*
Brassicaceae	*Euclidium tenuminosus*	Chamaephyta frutescenia		*
Brassicaceae	*Alyssum heterotrichum*	Hemicripto Caespitosa	*	
Brassicaceae	*Cramb kotschyana*	Hemicripto.rosulata		*
Brassicaceae	*Capsellla bursa pastoris*	Therophyta Scaposa	*	
Asteraceae	*Lactuca khorasanica*	Hemicryptophytes		*
Asteraceae	*Artemesia aucherii*	Chamaephyta frutescenia		*
Asteraceae	*Sonchus olevaceaus*	Therophyta Scaposa		*
Asteraceae	*Tragopagon longirostris*	Geophyta radicigemma		*
Asteraceae	*Achillea wilhelmssig*	Hemicripto Caespitosa	*	
Asteraceae	*Acropliton repens*	Hemicripto Caespitosa		*
Asteraceae	*Seratula latifolia*	Hemicripto Caespitosa		*
Graniaceae	*Erodium cicutarium*	Therophyta caespitosa		*
Cunvulvulaceae	*Convolvulus arvensis*	Hemicripto.rosulata	*	
Iridaceae	*Gladiolus atrovioaceus*	Geophyta radicigemma	*	
Chenopodiaceae	*Chenopodium album*	Therophyta caespitosa		*
Alliaceae	*Allium bodeanum*	Geophyta-bulbosa		*
Amarylliadaceae	*Ixiolirion tataricum*	Geophyta radicigemma		*
Rhamanaceae	*Sanguisorba minor*	Hemicripto Caespitosa		*
Hypericaceae	*Hypericum scabrum*	Hemicripto Caespitosa	*	
Rubiaceae	*Galium verum*	Hemicripto Caespitosa		*
Podophyllaceae	*Bongardia chrysogonum*	Hemicripto Caespitosa	*	
Apiaceae	*Ferula gumosa*	Geophyta radicigemma		*
Apiaceae	*Ferula assa foetida*	Geophyta radicigemma	*	
Liliaceae	*Eremurus kopedaghensis*	Geophyta-bulbosa		*
Scrophularicaceae	*Verunica argute serrata*	Therophyta caespitosa	*	
Ephedraceae	*Ephedra procera*	Chamaephyta frutescenia		*

Highly successful ecotourism can support biodiversity conservation by influencing national policy. For example, WUNDER (2000) reported that a tourism lobby has successfully resisted efforts to open a biodiversity-rich site in Ecuador to oil exploration and the Government of Mozambique is establishing large conservation areas as a key element of its tourism development strategy. However, tourism on a scale that can generate this degree of political support also carries serious risks of negative environmental and social impacts (KISS, 2004).

To protect the biodiversity of PAs, all necessary facilities and equipment should be procured. Environmental codes should be developed and enforced to protect unique and fragile PAs and other natural resources. These codes should be strict and free of misinterpretation and misuse. More specifically, the laws related to the environment and PAs should be updated and amended for sustainable development. In addition, the DoE, various management levels, NGOs and local communities should be empowered to enforce these environmental codes. Significant monetary fines should be used to enforce code violations, and the revenue from fines should be used for the improvement and protection of local PAs. The capacity of the DoE (at national, provincial and local levels) should be strengthened to work with and influence other ministries, the media, and the private sector. The DoE should be helped in fulfilling its mandate by the Government, the Legislature and the Judicature (KOLAHI *et al*., 2012).

Conclusions

Based on findings of this study, Significant differences between high pressure and low pressures zones show different conservation management strategies in the mentioned areas from ecotourism point of view. Considering long history of "Tandoureh" National Park and also the adverse condition of the biodiversity indices at high pressure zone in Cherlagh Area, the executive solution are recommended in order to modify the existing conditions: (i) the high pressure area should be under conservation and tourism managements frequently for environmental remediation; (ii) the tourist dispersal should occur temporarily and short term periods in Cherlagharea, so that it will be prevented from population dispersal in one area and consequently the subsequent adverse impacts on flora. If some actions have not been taken in Cherlagharea, this area will be under adverse threat of ecotourism similar to Chelmir area.

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