Effect of ecotourism on plant biodiversity in Chelmir zone of Tandoureh National Park, Khorasan Razavi Province, Iran

AMIRHOSSEIN ZARGHI[1], SEYED MOHSEN HOSSEINI[2,]

[1]Research and Science Branch of Ahvaz, Khoozestan, Iran

[2]Department of Forestry, Faculty of Natural Resources and Marine Science, Tarbiat Modares University, Noor, Mazandaran, Iran. Tel.: +989111213898, Fax. +981226253499, email: hosseini@europe.com, hosseini@modares.ac.ir.

ABSTRACT

Zarghi A, Hosseini SM. 2014. Effect of ecotourism on plant biodiversity in Chelmir zone of Tandoureh National Park, Khorasan Razavi Province, Iran. Biodiversitas 15: 224-228. Tourism in protected areas is generally viewed as a primary source of promoting economic and social growth to local communities and commonly perceived to safeguard biodiversity. However, in the last few decades an increasing number of visitors along with more diverse activities are having greater impacts on nature. Hence due to importance of ecotourism in Iran, the effect of ecotourism on plant biodiversity in Chelmir 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 1m^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 Biopast software and the biodiversity (Shanon, Simpson) richness (Menhinick, Margalef) evenness (Dominance, Berger-Parker) and dominance (Evenness, Equitability) indices were calculated. 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 results indicate that the diversity, richness, dominance and evenness indices show significant effects of ecotourism on biodiversity indices.

Keywords: Biodiversity, dominance, ecotourism, evenness, richness

INTRODUCTION

To prevent the loss of biodiversity, many protected areas have been established throughout the world. Most protected areas, particularly in developing countries, were established in remote and peripheral regions largely occupied by marginalized and extremely poverty stricken populations (Sanderson 2005). Protected areas (PAs) play critical roles in safeguarding biodiversity and maintaining the crucial services provided by the natural systems. They have an important role in the evolving challenge of maintaining a sustainable world (Kolahi et al. 2013). It is estimated that as many as25% of the world's species could become extinct in the next few decades at a rate of 27,000 species per year (Nyaupane and Poudel 2011). Almost all countries have set aside at least a part of their territory for the purpose of nature conservation (Nolte et al. 2010). More than 161,991 PAs have been reported (PPW 2011), and this number is still increasing.

The discussion on tourism and biodiversity tends to focus on the (negative) impacts of tourism on biodiversity. As a consequence, negative impacts have been quickly observed for wildlife species and habitats due to air and water pollution, vegetation removal for tourist facilities and infrastructures (refuges, camping sites, roads, etc.), reductions in plant and animal fitness, habitat loss and degradation (Steidl and Anthony 2000; Kelly et al. 2002; Manor and Saltz 2003; Amo et al. 2006; Rossi et al. 2006; Griffin et al. 2007).

Different types of activities including camping and trampling often result in changes in species richness, with taxa more susceptible to damage being lost from a community, but others able to colonize disturbed sites. Trampling of the fragile field mark vegetation along the highest mountain ridges in Australia resulted in a decline in native species richness on the track compared to adjacent vegetation, as well as a decline in the abundance of species (McDougall and Wright 2004). The impacts of digging 'cat-holes' was experimentally tested across a range of vegetation types in Tasmania and digging resulted in lower overlapping cover values for a wide range of plant species in most communities sampled (Bridle and Kirkpatrick 2003).

Soil compaction can occur from a range of visitor activities in protected areas such as trampling, camping, horse-riding and mountain biking (Good 1995; Goeft and Alder 2001; Smith and Newsome 2002; Talbot et al. 2003; Turton 2005). For example, both formal and informal campsites in Warren National Park in Western Australia were found to have higher penetration resistance and bulk density than controls with formal campsites having 304%

greater penetration resistance than controls. This was likely to result in decrease in soil moisture and increased erosion (Smith and Newsome 2002).

The addition of nutrients from human waste disposal (such as urine and fecal material) by bushwalkers and campers can result in a change to species composition due to competitive displacement (Bowman and Steltzer 1998). This can create feedbacks for continuing change and also benefit weed species, leading to changes in vegetation communities. However, research in Tasmania found a beneficial effect of low levels of nutrient addition (artificialurine) on vegetation, with increased growth of many taxa and the only obvious negative effect was a reduction in cover of moss at one site (Bridle and Kirkpatrick 2003).

Iran has a long history of nature protection (Yakhkashi 2002). 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 (Table 1) (Kolahi et al. 2013).

Parks, protected areas, and other natural areas in Iran and across the world are considered as special places that have been regarded as natural and cultural assets attracting many local, national, and international tourists (Kolahi et al. 2014; Darvishsefat 2006; Moore et al. 2009). Parks are

Table 1. Protected and other natural areas in Iran (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

parts of cities or the country sides where visitors can enjoy themselves, but little tourist revenue reaches park management, despite the fact that this revenue is much needed.

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.

MATERIAL 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 of Iran and close to the Turkmenistan border. 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 (Aghamiri et al. 2006). In Figure 2, the sampling area has been depicted.

For evaluation of the plant biodiversity 60 samples of $1m^2$ (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 Biopast software and the biodiversity (Shanon, Simpson) richness (Menhinick, Margalef) evenness
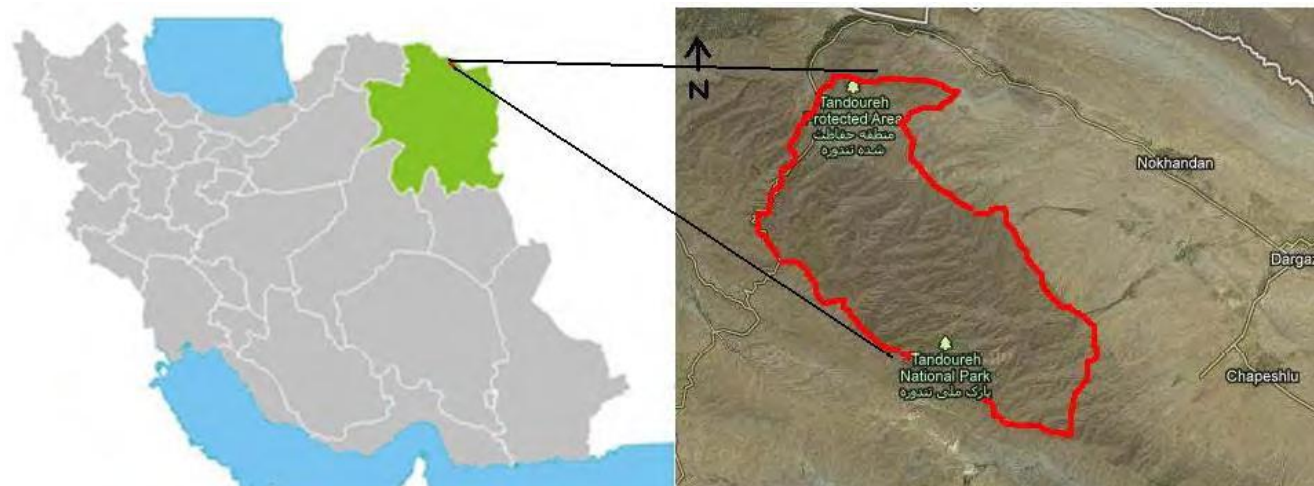

Figure 1. Sampling area in Chelmir area in Tandoureh National Park, Iran

Table 1. 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	Menhenick 1964	Dmn=S/√n
Berger-Parker	May (1975)	d = Nmax / N
Dominance	Harper (1999)	1-Simpson index
Evenness	Harper (1999)	eH/S
Equitabality	Harper (1999)	Shannon diversity divided by the logarithm of number of taxa

(Dominance, Berger-Parker) and dominance (Evenness, Equitability) indices were calculated. The mentioned indices were inserted in SPSS II software and the data normality was tested through Kolmogorov-Smirnov test. Due to data normality, non-paired T test was used in order to compare diversity analysis. A and B in the results indicate that the diversity, richness, dominance and evenness indices show significant effects of ecotourism on biodiversity indices and management strategies should be conducted for better conservation. Table 2 also shows the floristic list of Chelmir zone.

Data analysis

The indices which have been evaluated in this paper have been indicated above. As in has been presented, the biodiversity (Shanon, Simpson), richness (Menhinick, Margalef) evenness (Dominance, Berger-Parker) and dominance (Evenness, Equitability) indices were calculated in this study and the formulas have been presented in Table 2.

RESULTS AND DISCUSSION

There are no statistics about ecotourism in Iran's. However, it is estimated to be very low (BHPAs 2011), 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 Mahmoodi et al. (2005) found 119 species in protected Kelarabad forests, however the dominant species were *Alnus* spp.

Rezazadeh (2008) reached the same conclusion and found 149 species in Khoshkedaran forests which was near Mahmodabad forests. A sit clear in the mentioned studies, high number of plant species is related to natural condition of parks but many of the negative impacts from tourism occur when the amount of visitors is greater than the environments ability to cope with the number of visitors. 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, dominance and evenness indices in studied area. In these zone two factors of (i) existence of *Ailanthus altissima* species in high pressure zone (ii) anthropogenic factors decline all the biodiversity indices.

Lorestani et al. (2011) reached the same conclusion in Safaroud forest park which was divided into three high-pressured, low-pressured and without pressured zones. 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). Golegi (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 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.
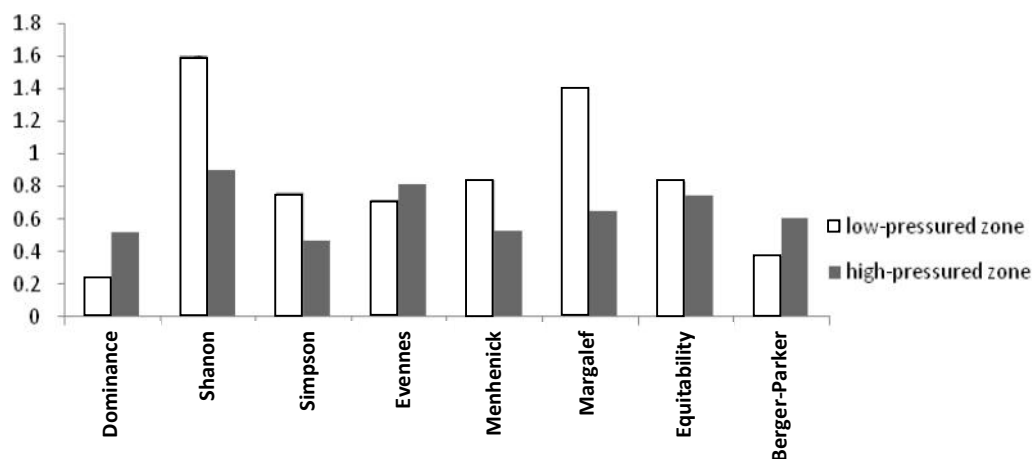

Figure 2. Diversity, richness, dominance and evenness indices show significant effects of ecotourism on biodiversity.

Table 2. Floristic list in studied area

Family	Scientific name	Forms
Asteraceae	*Artemisia aucheri*	Chamaephyta-frutescentia
Asteraceae	*Artemisia kopedaghensis*	Chamaephyta-frutescentia
Asteraceae	*Gundelia tournefortii*	Hemicryptophytes
Asteraceae	*Cousinia arida*	Hemicryptophytes
Asteraceae	*Koelpinia tenuissima*	Therophytes
Asteraceae	*Lactuca khorasanica*	Hemicryptophytes
Asteraceae	*Centaurea virgata*	Hemicryptophytes-Scaposa
Apiaceae	*Eryngium* sp.	Chamaephyta-frutescentia
Apiaceae	*Zosima absinthifolia*	Therophytes
Apiaceae	*Bunium persicum*	Geophyta-radicigemma
Apiaceae	*Korovinia tenuisecta*	Hemicryptophytes
Apiaceae	*Falcaria vulgaris*	Hemicryptophytes
Rubiaceae	*Galium verum*	Hemicripto-caespitosa
Poaceae	*Aegilops triuncialis*	Therophyta-caespitosa
Poaceae	*Poa bulbosa*	Geophyta-bulbosa
Poaceae	*Agropyron trichophorum*	Hemicripto-caespitosa
Poaceae	*Cynodon dactylon*	Geophyta-rhizomatosa
Lamiaceae	*Perovskia abrotanoides*	Hemicripto-caespitosa
Lamiaceae	*Phlomis cancellata*	Hemicripto-caespitosa
Solanaceae	*Hyoscyamus squarrosus*	Hemicripto-caespitosa
Papaveraceae	*Papaver alpinum*	Therophyta-caespitosa
Fabaceae	*Medicago sativa*	Hemicripto-caespitosa
Brassicaceae	*Eruca sativa*	Therophytascaposa
Brassicaceae	*Crambe kotschyana*	Hemicriptorosulata
Brassicaceae	*Cryptospora falcata*	Therophytascaposa
Brassicaceae	*Capsella bursa-pastoris*	Therophytascaposa
Chenopodiaceae	*Eurotia ceratoides*	Chamaephytafrutescentia
Chenopodiaceae	*Chenopodium botrys*	Therophyta-caespitosa
Ephedraceae	*Ephedra procera*	Chamaephyta-frutescentia
Iridaceae	*Gladiolus atroviolaceus*	Geophyta-radicigemma
Hypericaceae	*Hypericum scabrum*	Hemicripto-caespitosa
Convolvulaceae	*Convolvulus arvensis*	Hemicripto-rosulata
Convolvulaceae	*Convolvulus cantabrica*	Hemicripto-rosulata
Malvaceae	*Malva neglecta*	Hemicripto-caespitosa

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 Chelmir 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 Chelmir area, so that it will be prevented from population dispersal in one area and consequently the subsequent adverse impacts on flora.

Growing population, changing patterns of settlement, environmental pollution of cities, and more needs for leisure have increased the importance of recreation places. Meanwhile, lack of financial resources to create or form recreational places, e.g., parks, has been conducted by the management of parks to evaluate the economic values of parks. In recent years, payment for park services has emerged as an innovative option to provide incentives for sustainable park management (Hein 2007). Valuation park

services, based on people's preferences (Kumar et al. 2010), 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 (McCool 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; Kolahi et al. 2012a).

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. 2012b).

CONCLUSION

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 Chelmir 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 Chelmir area, so that it will be prevented from population dispersal in one area and consequently the subsequent adverse impacts on flora.

ACKNOWLEDGMENTS

REFERENCES

Aghamiri H, Golestani H, Bijani M. 2006. Tandoureh National Park. Envoirmental protection office of Khorasan Razavi Province, Iran. [Persian]

Amo L, Lopez P, Martin J. 2006. Nature-based tourism as a form of predation risk affects body condition and health state of *Podarcis muralis* lizards. Biol Conserv 131: 402-409.

BHPAs. 2011. Department of the Environment of Iran, GIS and Remote Sensing Section, Statistics for November 2011, Tehran.

Bowman WD, Steltzer H. 1998. Positive feedbacks to anthropogenic nitrogen deposition in Rocky Mountain alpine tundra. Ambio 27: 514-517.

Bridle K, Kirkpatrick JB. 2003. Impacts of nutrient additions and digging for human waste disposal in natural environments, Tasmania, Australia. J Environ Manag 69: 299-306.

Buckley R. 2012. Tourism, conservation and the Aichi targets. PARKS 18 (2): 12-19.

Darvishsefat A. 2006. Atlas of protected areas of Iran. University of Tehran, Tehran.

Goeft U, Alder J. 2001. Sustainable mountain biking: a case study from the southwest of Western Australia, Journal of Sustainable Tourism. 9: 193-211.

Golegi E. 2011. Impact of ecotourism on biodiversity indices in Chaldare forest park. J Sci Tech Nat Resour 6 (3): 85-97

Good R. 1995. Ecologically sustainable development in the Australian Alps. Mountain Res Dev 15: 251-258.

Griffin SC, Valois T, Taper ML, Mills LS. 2007. Effects of Tourists on Behavior and Demography of Olympic Marmots. Conserv Biol 21: 1070-1081

Hein L. 2007. Environmental economics tool kit: Analyzing the economic costs of land degradation and the benefits of sustainable land management. 2nd ed. United Nations Development Program (UNDP) and Global Environment Facility (GEF), The Netherlands.

Hosseini SM, Goleiji EL, Kiadaliri M. 2011. Effect of ecotourism on plant biodiversity in Chaldoran Forestry park. J Sci Tech Nat Resour 3: 85-97.

Hussain SA, Barthwal SC, Badola R, Rahman, SMT, Rastogi A, Tuboi C, Bhardwaj AK. 2012. An analysis of livelihood linkages of tourism in Kaziranga National Park, A Natural World Heritage Site in India. Parks 18 (2): 32-43.

Kelly C, Pickering CP, Buckley RC. 2002. Impacts of tourism on threatened plant taxa and communities in Australia. Environ Manag 4: 37-44.

Kolahi M, Sakai T, Moriya K, Makhdoum MF, Koyama L. 2013. Assessment of the effectiveness of protected areas management in Iran: Case Study in Khojir National Park. Environ Manag 52: 514-530

Kolahi M, Sakai T, Moriya K, Makhdoum MF. 2012b. Challenges to the future development of Iran's protected areas system. Environ Manag 50 (4): 750-765.

Kolahi M, Sakai T, Moriya K, Yoshikawa M, Esmaili R. 2014. From paper parks to real conservations: Case study of social capital in Iran's biodiversity conservation. Intl J Environ Res 8 (1): 101-114.

Kolahi M, Sakai T, Moriya K, Yoshikawa M. 2012a. Data mining recreation values and effective factors in ecotourism willingness to pay: A perspective from Iran's Parks. Readings Book, the Global Business and Technology Association, New York.

Kumar P, Verma M, Wood MD, Negandhi D. 2010. Guidance manual for the valuation of regulating services. United Nations Environment Programme (UNEP), New York.

Lorestani B, Cheraghi M, Yousefi NN. 2011. Phytoremediation potential of native plants growing on a heavy metals contaminated soil of copper mine in Iran. World Acad Sci Eng Technol 77:377-382.

Mahmoodi J, Zahedi Amiri GH, Adeli E, Rahmani R. 2005. An Acquaintance with the relationship between plant ecological groups and the soil characteristics in a Kelarabad Plain forests (in North of Iran). Iranian J Nat Resour 58: 351-362. [Persian]

Manor R,, Saltz D. 2003. Impact of human nuisance disturbance on vigilance and group size of a social ungulate. Ecology 13: 1830-1834.

McCool SF. 2006. Managing for visitor experiences in protected areas: promising opportunities and fundamental challenges. Parks 16 (2): 3-9.

McDougall KL, Wright GT. 2004. The impacts of trampling on fieldmark vegetation in Kosciuszko National Park Australia. Austr J Bot 52: 315-320.

Miller A, Leung YF Lu DJ. 2012. Community-based monitoring of tourism resources as a tool for supporting the convention on biological diversity targets: A preliminary global assessment. Parks 18 (2): 120-131.

Moore SA, Crilley G, Darcy S, Griffin T, Taplin R, Tonge J, Wegner A, Smith A. 2009. Designing and testing a park-based visitor survey. CRC for Sustainable Tourism Pty Ltd., London.

Nolte C, Leverington F, Kettner A, Marr M, Nielsen G, Bomhard B, Stolton S, Stoll-Kleemann S, Hockings M. 2010. Protected area management effectiveness assessments in Europe: A review of application, methods and results. Bundesamt fu¨r Naturschutz (BfN), Federal Agency for Nature Conservation Konstantinstrasse, Germany.

Nyaupane GP, Poudel S. 2011. Linkages among biodiversity, livelihood, and tourism. Anna Tour Res 38 (4): 1344–1366.

PPW [Protected Planet website]. 2011. www.protectedplanet.net, Accessed 23May 2011.

Rezazadeh M. 2008. Survey Ecology in Protect Area of Mazandaran (Case Study: Khoshkedaran). Bandar Anzali Cultural Researches, Tehran. [Persian]

Rossi G, Parolo G, Zonta LA, Crawford JA, Leonardi A. 2006. *Salix herbacea* L. fragmented small population in the N-Apennines (Italy): response to human trampling disturbance. Biodiv Conserv 15: 3881-3893.

Sanderson S. 2005. Poverty and conservation: The new century's ''Peasant Question?''. World Dev 33 (2): 323-332.

Smith A, Newsome D. 2002. An integrated approach to assessing, managing and monitoring campsite impacts in Warren National Park, Western Australia. J Sustain Tour 10: 343-359.

Steidl RJ, Anthony RG. 2000. Experimental effects of human activity on breeding Bald Eagles. Ecology 10: 258-268.

Talbot LM, Turton SM, Graham AW. 2003. Trampling resistance of tropical rainforest soils and vegetation in the wet tropics of north east Australia. J Environ Manag 69: 63-69

Turton SM. 2005. Managing environmental impacts of recreation and tourism in rainforests at the Wet Tropics of Queensland World Heritage Area. Geograph Res 43: 140-151.

Yakhkashi A. 2002. Identification, Conservation and Rehabilitation of Iranian Environment. Institute of Excellent Education of Agriculture, Tehran.