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Evaluating plant species diversity in urban parks of Kio and Shariati in Khorramabad county

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Abstract

In this study, plant species diversity in two urban parks of Kio and Shariati in Khorramabad County were compared. A number of 30 sample plots were sampled from each park using systematic random sampling technique and in each sample plot characteristics of plant species, number of species, diameter at breast height of all trees, height of all trees and shrubs as well as large and small diameters of crown were measured. Simpson's diversity and evenness indices as well as Shannon Hill, and Brillouin diversity indices were used to assess plant diversity. Species richness was calculated using the number of species in each sample plot. Species diversity indices were calculated using the software Metadology Ecologycal and the t test was used to assess the significance of differences of these two indexes between the Kio and Shariati Parks. The results show that Kio Park had the higher average Shannon (1.514), Simpson (0.695), Hill (2.854) and Briloin (1.061) diversity indices indicating higher species diversity than Shariati Park. Also this park also has the higher Simpson evenness index (0.792) and the species richness (3.633), which indicates a better distribution and abundance of species in the park. The difference between averages of diversity indices at confidence level of 1% and the difference between averages of the evenness index at 5% were significant.

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Introduction

Biological diversity is one of the important features of the biological communities. Variety of organisms, measuring the diversity and testing assumptions about the causes of the diversity are among the issues that have long been of interest for ecologists (Sohrabi and Akbarinia 2004). The concept of biodiversity is a scientific basis for public demand and for protecting the natural ecosystems in reserves and parks and it is an obstacle to industrial forestry and other natural resource development projects (Pourbabaei and Dado, 2005). The importance of urban forestry in countries like Iran is very high. Although cities in Iran are rarely located in forested areas, the planting and maintenance of green spaces with tree cover is of high importance for improving the city environment and preventing dust storms, keeping groundwater, preventing uncontrolled urban development, amenity of urban environment and recreation (Zare *Et. al*., 2009). For this reason, maintaining and expanding any green space for protecting woody species and woodlands is vital because of its multilateral efficiency (Majnounian, 1995). Undoubtedly, trees and urban green spaces play an important role in improving the environment and promoting of qualitative and quantitative aspects of life of urban-dwellers. In recent decades, urban green spaces of most cities have been changed that unfortunately these changes are not suited with culture, nature and climate of the region. As a result of urbanization, native species are being destroyed so that in developed urban green space, contribution of native plants is increasingly diminishing. The use of native species in urban parks can help to preserve the species. The issue of diversity in urban green space development has been ignored. However, with increasing plant species in man-made ecosystems of urban areas, the sustainability of the environment will be increased, in contrast reduced diversity will cause disrupted stability of components related to ecological processes. Because of few studies on the selecting and planting particular trees in urban environments, ecosystem diversity in urban areas has been extremely reduced that has created apparently uniform spaces. Developing diversity in urban green space creates beautiful landscape and visual diversity for public. Diversity of tree species also increases the efficiency of trees to play their roles in urban environment (Zare *Et. al*., 2009). Creating parks, gardens and green spaces in cities and suburbs have a substantial impact on social activities and providing a healthy economy and people activities the work and it make the urban life satisfactory. In fact, the main reason for the creation of green space in the city is to decrease wind speed, prevent abnormal changes in temperature, reduce dust and air pollution, aesthetic and mental health. It should be noted that management of urban green spaces is not limited to certain issues such as the preservation of green space and trees, or management of urban parks and green belts of cities but it covers a wide range of issues including planning activities related to planting and establishment of diverse plant species compatible with climatic conditions. Urban parks are a form of public urban green spaces that are created and managed based on social and environmental performance. Basically, the nature of these spaces is so that all classes of people can use these spaces and their distinction suburban parks is that these parks are part of the natural environment which are selected and managed for conservation or recreation (Zare *Et. al*., 2009). Assessing the biodiversity in urban and suburban parks in Flander (Cornelis and Hermy, 2004) showed that urban and suburban parks can play an important role in the conservation of biodiversity, especially in highly urbanized areas like Flander (Belgium), also they may have high species diversity especially if they be less different from semi-natural habitats. The larger parks can contribute more to biodiversity conservation compared to smaller ones. In order to investigate the diversity and distribution of trees in urban parks in the southern part of Bangalore city, India (Nagendra and Gopal, 2010), a number of 127 sample plots were taken to assess the distribution of trees in parks around the city. Based on the results the distribution of trees was largely dominated by a few number of native species (non-native species about 77%) also it was found that

the older parks had higher species diversity than the recently established ones. In order to assess plant diversity in urban ecosystems as indicators for environmental planning in the city of Coimbra (Portugal), the results showed that indices of plant richness and diversity had a trend similar to landscapes and the highest richness and diversity indices were found in olive stands because of presence of grass plants (Barrico *Et. al.*, 2012). Given the importance of environmental and ecological functions of trees and shrubs and the increasing degradation of natural ecosystems and the slow process of replacing the forests, need for urban parks grows increasingly for various reasons, including the possibility of further protection to the park and its close relationship with people life, as well as the importance of reforestation in urban areas with different species. Ecosystems such as urban parks can have beneficial effects on performance aspects such as attracting tourists urban economics and management efforts to conserve and enhance the biodiversity. The present study was performed to examine the diversity of plant species in urban parks of Kio and Shariati in Khorramabad County, Lorestan province.

Materials and methods

The study area

The present study was carried out in urban parks of Kio and Shariati in Khorramabad County. Kio park is located at northwest part of Khorramabad city and Shariati park is located at East part of this city, The areas of these parks is 256666 m² and 251391 m², respectively and are classifies as regional urban parks (fig1 and 2).

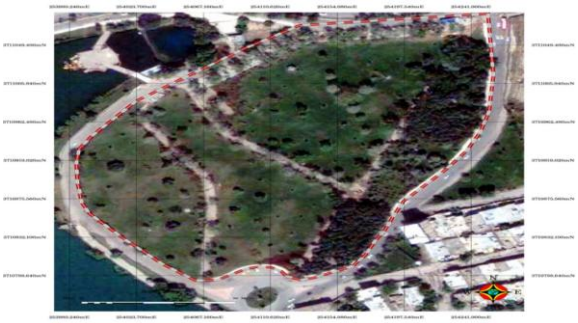

Fig. 1. Kio urban park.

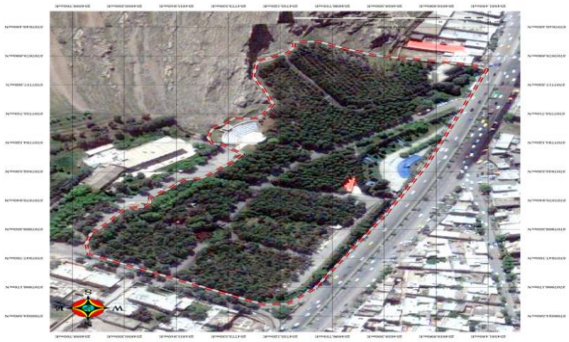

Fig. 2. Shariati urban park.

Research methodology

For each park, a number of 30 circular sample plots with a radius of 12 m (based on a minimum area) in Kio Park and with a radius of 6 meters (based on a minimum area) in Shariati Park were taken using a systematic random sampling method (Zobeiry, 2011), (Moghadam, 2002). In each sample plot characteristics of plant species, number of species, diameter at breast height of all trees, height of all trees and shrubs as well as large and small diameters of crown were measured.

Statistical Analysis

Data analysis was carried out using diversity indices of Simpson, Hill, Shannon and Brillouin as well as evenness index of Simpson (Table 1). To calculate the species richness the number of species in each plot was used and to calculate diversity and evenness indices the characteristics including species type and abundance were applied using Ecologycal Metadology software. The t-test was used in order to analyze data of species richness, diversity and evenness indices in both Kio and Shariati parks.

Results

The results showed that there was 36 and 15 plant species in Kio and Shariati urban parks, respectively (Table 2).

Kolmogorov-Smirnov test was performed to assess data normality.The test showed that all data are normally distributed.

The mean and standard deviation values of species richness index in Kio park was higher than Shariati park that are shown in (fig 3).

Table 1. Diversity, evenness and species richness indices.

Index	Name of the indicator	References	formula
Richness	species richness	[Magurran, 1988]	R = S
Evenness	Simpson	[Simpson, 1949]	$\hat{\lambda}_{max} = \frac{1}{S}$
Diversity	Shannon – Winner	[shannon, 1949]	$H' = -\sum_{i=1}^{S^*} (P_i \mathrm{Ln} P_i)$
	Simpson	[Simpson, 1949]	$\lambda = \sum_{i=1}^{S} P_i^2$
	Brillouin	[Margalef, 1958]	$H_B = \frac{1}{N} log\left(\frac{N!}{n_1!\, n_2! \ldots}\right)$
	Hill	[Hill, 1973]	$\frac{1}{\lambda} = \frac{1}{\sum_{i=1}^{s} P_i^2}$

Table 2. List species in Kio and Shariati urban parks.

Park name	tree Species	shrub Species	remainder
Kio	*Platanus orientalis, Pinus brutia, Fraxinus rotundifolia, Ailanthus altissima , Cupressus arizonica syn.c.glabra, Cupressus sempervirens, Morus alba, Buxus Sempervirens, Hibiscus syriacus L. , Pinus langifolia, Thuja orientalis, Populus euphratica, Cupressuss sempervirens, Pinus mogo, Acer velutinum , Salix alb, Daphne odora, Robinia pseudoacacia, Cercis sp (L), Cedrus atlantica, Populus deltoeides, Acer negundo*	*Euonymus japonicus var. aureo-marginatum, Myrtus communis, Rosa hybrid, Ligustrum vulgaris, Berberis Thunbergii , Rosa persica, Rosa altissimo, Rosa chinensis, Punica granatum*	*Canna indica, Ycca filamentosa, Antirrhinum majus, Physalis alkekeng, Lonicere caprifolia*
Shariati	*Platanus orientalis, Pinus brutia , Fraxinus rotundifolia, Ailanthus altissima ,Cupressus arizonica syn.c.glabra, Cupressus sempervirens ، Morus alba, Ulmus carpinifolia var umbraculifera, Buxus Semperviren, Hibiscus syriacus L.*	*Euonymus japonicus var. aureo-marginatum, Myrtus communis, Rosa hybrid*	*Rosmarinus officinale, Jasminum officinale*

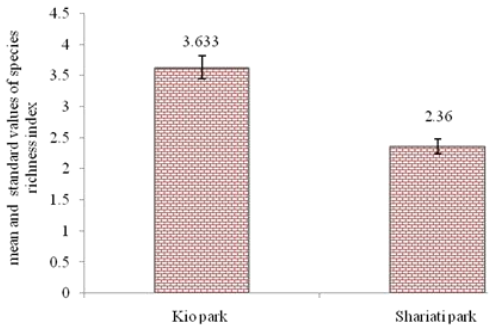

Fig. 3. The mean and standard deviation of species richness index on the basis of number species in the plot in Kio and Shariati parks.

The mean and standard deviation values of evenness index in Kio park was higher than Shariati park that are shown in (fig 4).

The Mean and standard deviation values of species diversity indices of Shannon, Simpson, Hill and Briloin are shown in (fig 5), indicating that species diversity in Kio Park was higher than Shariati Park. Results of t test for comparing different indices of biodiversity in the Kio and Shariati Parks showed that diversity indices of Shannon-Wiener, Simpson, Hill, Briloin and species richness were significant at the confidence level of 99% (Table3).

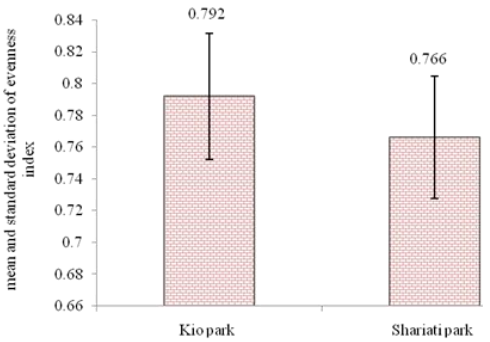

Fig. 4. The mean and standard deviation of evenness index in Kio and Shariati parks.

Table 3. Comparison of mean dependent variables by grouping Variable Parks (test t).

Dependent variable	Variable Grouping	Level Variable	Frequency	Mean	Standard deviation	T value	sig
Shannon	Parks	Kio park	30	1.514	0.624	4.595*	
		Shariati park	30	0.886	0.413		0.000
Simpson	Parks	Kio park	30	0.695	0.184	4.448*	
		Shariati park	30	0.469	0.208		0.000
Hill	Parks	Kio park	30	2.854	1.415	-4.051	
		Shariati park	30	1.729	0.556		0.000
Brillouin	Parks	Kio park	30	1.061	0.476	-4.610*	
		Shariati park	30	0.591	0.291		0.000
Evenness index	Parks	Kio park	30	0.792	0.142	-1.245**	
		Shariati park	30	0.746	0.141		0.218
Species richness index	Parks	Kio park	30	3.633	1.608	-3.814*	
		Shariati park	30	2.36	0.850		0.000

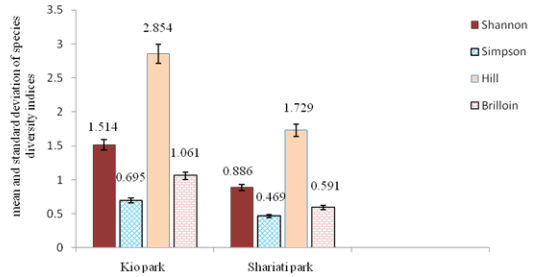

Fig. 5. The mean and standard deviation of species diversity indices in Kio and Shariati parks.

Discussion

Today a city without effective forms of urban green spaces is no longer conceivable. Cities as centers of concentration, activity and human life need to accept the structure and functioning of natural systems in order to ensure their stability. In this regard, urban green spaces play a major role as an integral and essential component of cities, and lack or shortage of these urban green spaces can lead to serious disorders in urban life. In evaluating the species richness, the total number of species was used instead of Margalef and Menhinick indices (Magurran, 1988), because although these two mentioned indices in calculating species richness in a given region attempt to present indices in which the number of species to be a function of sample plot size or number of species, but the their proposed functions show that in investigating two units with the same area and with same number of species but not same individual, the unit is more rich that has a lower number of individuals and this is questionable. Therefore, in this study, because the area is considered fixed parts and also to solve the above-mentioned problem, it assumes that the total number of all is adequate for calculating species richness.. Kio Park has more favorable ecological conditions (more moisture, and more fertile soil), thus it has a high biodiversity. In other words, Kio Park in addition to having higher diversity indices of in the park more than the law with evenness index value is higher. Since high biodiversity create more stable conditions (Rostami Shahraji and Pourbabaei, 2007), (Nagendra and Gopal, 2010) as a result stability and fertility of Kio Park is higher than Shariati Park. Evenness exerts large impact on biodiversity and evenness index in Kio Park is more than Shariati Park confirming the studies (Pourbabaei, *et al.*, 2000) that stated the evenness component has a greater impact on biodiversity. Based on field observation of the author and data provided by Municipality of Khorramabad city the slope in Kio and Shariati Parks were 12% and 42%, respectively. The high slope in Shariati Park makes the species richness and species diversity indices to be lower, as a result species diversity is low in this park indicating the negative effect of slope on species diversity (Esmailzadeh and Hosseini, 2008), (Hassanzad, 2004). Also the location of this park (in urban area) the human interventions are influencing on diversity in this park. Based on previous studies, by increasing the slope, biodiversity indices are decreased due to the more difficult habitat conditions such as decreased soil depth, and lower soil fertility confirming with the results (Sohrabi *et al.*, 2007), (Nagendra and Gopal, 2010), (Danekar and Azizi Galilian, 2011), (Majnounian, 1995). Species diversity indices of Shannon, Simpson, Hill, Briloin in Kio Park were much higher than Shariati Park indicating the higher species diversity of Kio park compared to Shariati Park. Simpson's evenness index in Shariati Park was also much lower than Kio Park indicating that species in the park are not evenly distributed. But the value of Simpson's evenness index was higher in Kio Park, indicating the more appropriate distribution of the species in this park. Reasons for lower species diversity and richness in Shariati Park may be that experts have not selected appropriate species and they have not used species compatible to the conditions of region especially native species. Most of species in the park are coniferous with permanent canopy making lower light and heat reaching to the floor and also these species cause soil acidification consequently lower number of species can establish and as a result species diversity and richness is low. In Shariati Park due to lack of available water resources, the species should be planted that need less water and can withstand water deficit conditions. The reason for the higher species diversity of Kio Park than Shariati Park may be that

the species in this park were used by experts to create a more diverse landscape. The other reason is the presence of Kio Lake and urban rivers and availability of water resources around the park (located near the fountain) and this allow planting more diverse trees and plants with more water need. Results of t test for comparing different indices of biodiversity in the Kio and Shariati Parks showed that diversity indices of Shannon-Wiener, Simpson, Hill, Briloin and species richness were significantat the confidence level of 99% Which reflects the higher richness and diversity of plant species in the Kio Park. According to the information obtained from this study, tree species can be used appropriately according to habitat and ecological needs of each park for plantation and in case of medicinal plants it should be note that medicinal plants need lower amount of nutrients with long life and high compatibility. Thus, more researches are required to investigate the effects of these species on species diversity of urban parks. Also due to lack of water and poor soil quality in Shariati Park, it is suggested that native plant species useful for designing the green space to be identified and planted.

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