Influence if Urban Park Size and Shape on Bird Species Richness: Case study: Parks of Isfahan

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Introduction
The increasing trend of urbanization has highlighted the importance of city parks for providing opportunities for recreation and leisure activities and as biodiversity hotspots in urban areas. On the other hand, conservation of urban biodiversity has become one of the aims of urban managers in many cities of the world and it is even possible to find different kinds of reserves in urban areas. Higher richness of bird species can be considered as a reflection of the healthiness of the park and may satisfy visitors to a higher extent, feeling to be in a more natural environment. Therefore, attracting birds to city parks can be considered as one of the aims of urban managers. The purpose of this study is to examine the relationship of area, shape and crowdedness of city parks with their bird species richness.

Material and methods
The study was conducted in Isfahan, one of the largest cities in central Iran. Mean annual precipitation is approximately 124 mm in Isfahan. Temperature falls to -1°C in winter and rises to 31°C in summer with a mean annual of 16°C. 13 parks among the 35 main city parks of Isfahan were randomly selected. Bird census was carried out in all the selected parks in spring, using replicated strip transects. The obtained bird species richness in each park was standardized using the rarefaction method. Bird species diversity was calculated using Shannon-Wiener index. Area, circumference and green space of the parks were obtained by employing Quick bird satellite images and ArcView GIS 3.3 software. To obtain an index of the level of disturbance that the birds are facing with in each park, the number of park's visitors in a specified time period was counted. According to the obtained indices, the parks were classified in three disturbance levels.

Results
Area, circumference and green space of the parks were obtained by employing Quickbird satellite images and ArcView GIS 3.3 software.
In general, 1184 birds from 24 species were recognized in the parks. 62% and 21% of the species observed in all of the studied parks were among House sparrow *Passer domesticus* and carrion crow *Corvus corone,* respectively. Barn swallows *Hirundo rustica* (4.2%), Raven *Corvus corax* (3.6%), laughing dove *Streptopelia senegalensis* (2.2%) and Magpie *Pica pica* (1.8%) were also relatively abundant. Relative abundance of other observed species were as follows: white wagtail *Motacila alba* (0.67%), rock dove *Columba livia* and starling *Sturnus vulgaris* (equally 0.59%), white-eared bulbul *Pycnonotus leucogenys* (0.42%), black-headed gull *Larus ridibundus* (0.33%), turtle dove *Streptopelia tutus* and yellow wagtail *Motacila flava* (equally 0.16%). The rest of species include blackbird *Turdus merula*, black-throated thrush *Turdus ruficolis*, redwing *Turdus iliacus*, rook *Corvus frugileus*, song thrush *Turdus philomelos*, nightingale *Luscinia megahynchos*, chaffinch *Fringilla coelebs*, crimson-winged finch *Rhodopechys sanguine*, common swift *Apus apus* and a kind of warbler *Sylvia sp.* and a kind of sparrow *Petronia sp.,* each had a relative abundance of 0.84%.

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The largest diversity was observed in Baghe-Golha and Baghe-Ghadir parks with 13 and 12 species, respectively. The average bird species diversity (H') in Isfahan city parks ranged from 1.35 to 2.69.

A significant positive association between bird species richness and area of the parks was obtained (R^2 = 0.49, p = 0.008) (Fig. 1), while the relationship of the park edge (the proportion of park circumference to park area) with bird species richness was significantly negative (R^2 = 0.41, p = 0.018) (Fig. 2). Analysis of variance showed significant negative effect of disturbance on bird species richness ($F_{2,7}$ = 1.7, p = 0.002) (Fig. 3).

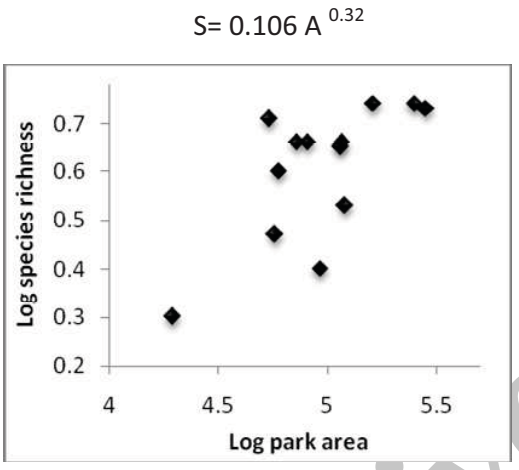

Fig. 1:The relationship between the park area (A) and species richness (S).

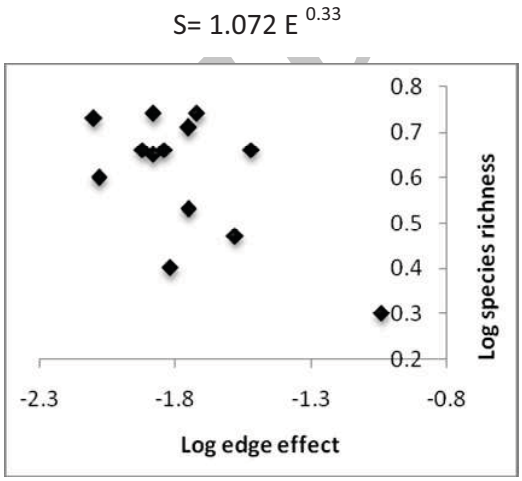

Fig. 2: The relationship between the edge effect (E) and species richness (S) in each park.

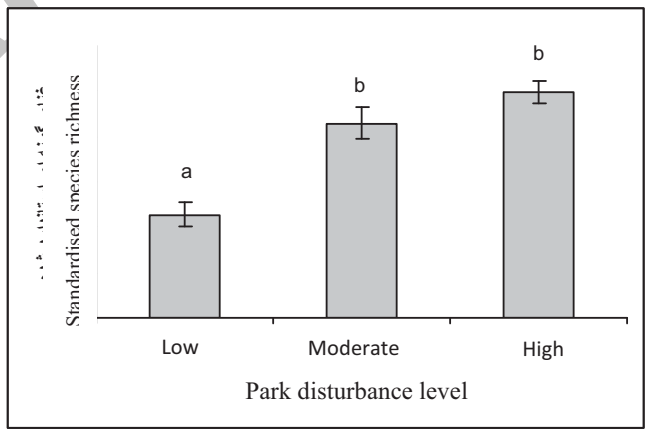

Fig. 3: Mean species richness in parks with different levels of disturbance. Mean values marked with a common letter are not significantly different from each other (Tukey multiple comparison test, P<0.05).

Conclusion

Results of this study revealed that size, shape and crowdedness influence bird species richness of city parks. These findings have management implications for attracting more bird species to city parks particularly at the planning stage. Larger parks and those with lesser external edges can potentially attract more bird species. The disturbance resulted from the crowdedness of parks negat ively influenced the bird species richness. Bird species observed in crowded parks were mostly ground foraging granivorous species such as house sparrow and carrion crow that are adapted to urban habitats. To attract birds to city parks and maintain the diversity of birds, parks should be designed and managed in a way to get the least influence from the physical environment of city.

Key words

Urban parks, Birds, Species richness, Edge effect, Disturbance level.