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Spatial decay of recreational services of urban parks: Characteristics and influencing factors

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ABSTRACT

Recent research on factors influencing park accessibility, equity and efficiency of park use has received increasing attention. These factors are mainly determined by the maximum distance to urban parks and associated park-based and user-based factors. Variations of recreational services caused by the spatial relationship between urban parks and residences are almost ignored. This paper investigates how recreational services decay from urban parks to residences and how this spatial decay is affected by factors relating to the service delivery. In this context, spatial decay means that the radiation strength of park services decline in dependancy of the spatial organization of the surrounding urban space. The results of this study highlight that the spatial distribution and distance as well as factors such as park space, the availability of other services, transport facilities and preferences, and age and gender of park visitors are related to the recreational services of urban parks. Our findings suggest that the quantification of spatial decays and the identification of relevant factors can help to avoid unfavorable spatial distributions of parks, so that an equitable and efficient park system can be achieved for all urban residents.

1. Introduction

As one of the most important components of urban green space, parks provide important recreational services that offer a variety of physical, social, and psychological benefits for residents (Wolch et al., 2014; Koohsari et al., 2015). The spatial distribution of urban parks greatly affects whether residents gain effective access to recreational services (Wen et al., 2013). For example, urban parks in northern Seoul were found to have less recreational value than in other areas due to their unequal distribution with respect to the surrounding land use, distribution of the population, and developmental intensity (Oh and Jeong, 2007). Such spatial inconsistency between the supply of recreational services and demand has raised equity concerns regarding urban park policies.

In many studies, accessibility is used as a measure of a park's ability to provide services, and distance to a park is considered as an important component of accessibility (Wen et al., 2013; Rossi et al., 2015). For example, Nicholls and Shafer (2001) evaluated equity and accessibility of local parks by analyzing fixed buffer zones. Although distance can be used to reflect the area of a park that provides services, it is often difficult to identify the appropriate distance at which park services become inaccessible. Moreover, recreational services of parks are not isotropic and homogeneous, but change with increasing distance. Some studies investigated distance decay effects and found a weakening of recreational services with increasing distance (Peschardt et al., 2012; Hooper, 2015). Four different curves have been identified to describe different decay effects of distance in previous studies, including exponential, secondary peak, classic and plateau curves (McKercher et al., 2008; Hooper, 2015; Rossi et al., 2015). However, distance decay effects could be very different among different types of parks due to variations in physical conditions and socio-cultural settings (Spinney and Millward, 2013). Thus, a more realistic method of validation for distance-decay models is needed for parks with different properties.

Recent studies started to incorporate park features into their investigation of distance-decay effects and employed gravity-based models for their description. These models assume that spatial interaction declines with increasing distance between park destinations and residential areas. For example, Lee and Hong (2013) developed a spatial disparity measure to quantify the inaccessibility of park services, and Zhang et al. (2001) evaluated spatial equity of park access using a population-weighted distance method. Although gravity-based models help to distinguish distance-decay effects for various types of parks, most of them set all parks within a defined geographic area as destination. This default setting might be not realistic, since residents may have only limited knowledge of all these parks (Zhang et al., 2001). Moreover, distance-decay effects may vary considerably depend-

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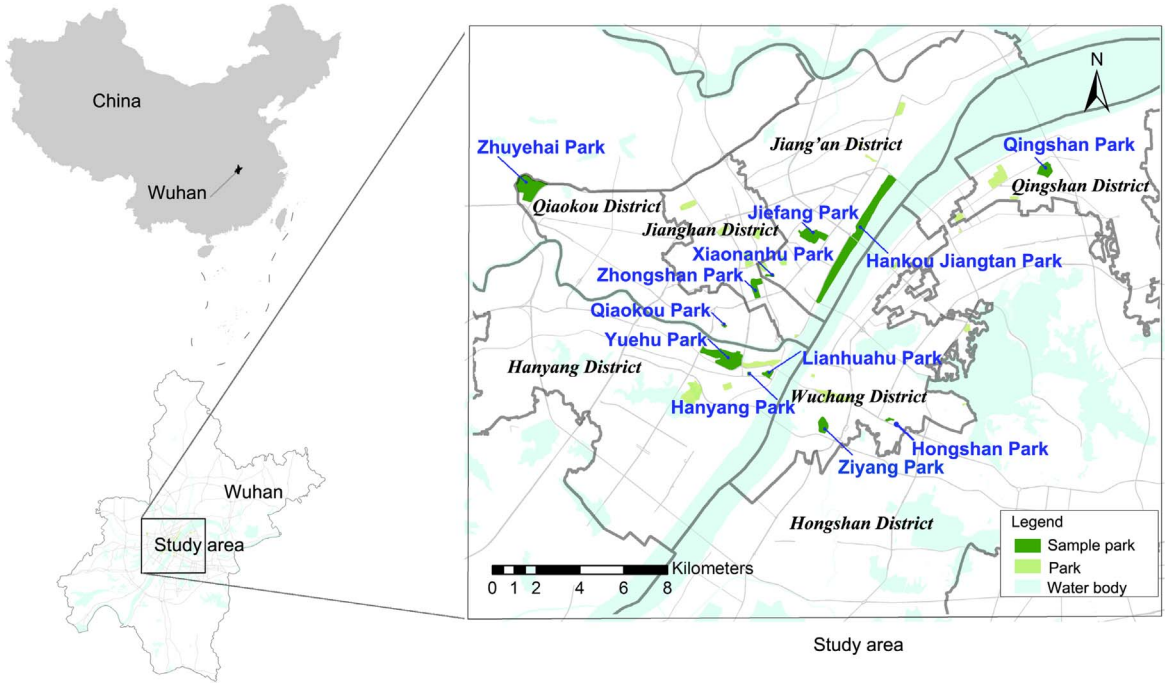

Fig. 1. Locations of sample parks in the city of Wuhan.

ing on the mode of travel in the same spatial distance. Wei (2017) and Dony et al. (2015) proposed a two-step floating catchment area method that incorporates a distance-decay parameter within a catchment to model spatial access to parks for different modes of transport. The major limitation of these studies is that the catchment area is defined at a fixed unit of distance without considering the type of parks (Dony et al., 2015). The quantification of the spatial decay of park services incorporating both the actual means of travel and park type still requires further research.

Most studies have demonstrated an understanding of the spatial-physical factors influencing park access and use (McCormack et al., 2010; Kaczynski et al., 2016). For example, van Herzele and Wiedemann (2003) found that the sense of space, the natural environment, the degree of quietness, and available park facilities were the most important factors affecting park use, while Erkip (1997) indicated that distance to the park was the key factor in determining park accessibility. Some other studies emphasized that the importance of such spatial-physical factors could be offset by socio-demographic factors (Moore et al., 2008; Macintyre et al., 2008; Lee, 2016). For example, Byrne and Wolch (2009) found that people may not visit nearby parks for cultural reasons. To fill this gap of knowledge, both physical and non-physical dimensions have been considered in recent studies (Lindsey et al., 2001; Wang et al., 2013). For example, Wang et al. (2015) found that both physical and social variables, such as proximity to the park and a pleasant walking experience, were statistically significant to perceived park accessibility in Brisbane, Australia. As designated modes of transport can be incorporated into the modeling of park access (Dony et al., 2015), the use of park services is also related to the availability of transport means and their actual utilization by residents. Although these factors have been studied separately or comprehensively in previous research, the associations between these factors and park services may still be varied by the type of park and city contexts.

With the rapid urban development in China over the past decades, a large number of green areas were converted into construction land. Urban parks have been built above all into the remaining vacant gaps, so that many cities have a very uneven distribution of parks today. Under such conditions, the spatial decay of recreational services might be even more complex. A better understanding of the spatial decay of park services in these cities is urgently needed. In this study, the spatial decay of recreational services and associated factors were examined in the city of Wuhan, PR China. The objectives of this study were 1) to identify the spatial decay of recreational services of urban parks in Wuhan, and 2) to identify influencing factors and their impact on service decay.

2. Methods

2.1. Study area and sample parks

Wuhan is a large city in the central region of China and covers an area of 8594 km^2. It is in a stage of rapid economic development and population growth. Thirty-three parks were managed by municipal government in the central urban area of Wuhan in 2016, which offer recreational opportunities and green space to the public. In order to identify the spatial decay of recreational services of these parks, 21 main public parks with more than 100,000 visitors per year were selected to investigate only parks with a rather typical pattern of use. Information about the parks and the annual number of visitors were collected from Wuhan Municipal Bureau of Landscape and Forestry in 2013. Considering the uneven spatial distribution of these parks, a stratified random sample was used to generalize the investigated sample based on park size and district location. Parks in each district were stratified into small (< 10 ha), medium (10–50 ha) and large parks (> 50 ha), and one sample with different categories of park size was selected for each district. Finally, a total of 12 sample parks were selected, representing 57% of the 21 main public parks in the central urban area of Wuhan. The geographic distribution of selected sampling parks is displayed in Fig. 1.

2.2. Data collection and preparation

To analyze the use of parks, 30 research assistants asked park visitors (aged 14–75 years) to fill in questionnaires in the 12 selected parks during the summers of 2015 and 2016. Visitors passing research assistants or resting in not too busy places were invited at random to participate in the investigation. All participants were informed about the purpose of the survey and ensured confidentiality before participat-