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Heterogeneity in resident perceptions of a bio-cultural heritage in Hong Kong: A latent class factor analysis

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ABSTRACT

There is an increasing recognition of ecosystem services provided by urban trees and their importance to urban resilience and sustainability through the preservation and enhancement of biological diversity so as to withstand disturbances and retain ecosystem functions as well as guarantee the well-being of current and future urban dwellers. However, the heterogeneous perceptions that urban residents may hold towards various ecosystem services have seldom been investigated. This study made a unique contribution to the growing body of literature on urban ecosystem services by examining the unobserved heterogeneity in resident perceptions of ecosystem services provided by a distinctive bio-cultural asset, urban heritage trees, in Hong Kong, via a novel application of latent class factor analysis which allows for considering the multidimensionality of latent factors and increases model parsimony. A total of 1075 face-to-face interviews were conducted with a stratified sample of residents about their perceived importance of two categories of distinctive ecosystem services provided by urban heritage trees: biological benefits and cultural benefits. The results indicated that, on average, both biological and cultural benefits of urban heritage trees were perceived to be important. Nevertheless, six classes were identified on the basis of different levels of two latent class factors, which differed markedly with respect to individual's perceived importance of ecosystem services provided by urban heritage trees, from fairly balanced to very divergent perceptions of biological services and cultural services. This heterogeneity was explained with covariates describing respondents' sociodemographic characteristics and activities at heritage tree sites. The results have implications for optimally tailoring promoting and participatory approaches, fostering improved communications with the general public, and nurturing overall support for urban heritage tree conservation from heterogeneous resident groups in order to achieve urban resilience and sustainability.

1. Introduction

The paradigm of ecosystem services and their valuation links human well-being inextricably with various natural components in the environment (Seppelt et al., 2011), in which the human dimension (e.g., people's perceptions and recognition) is deemed to be crucial to derive effective and useful policy recommendations for natural resource management and desirable social change (Menzel and Teng, 2010; Oteros-Rozas et al., 2014; Maraja et al., 2016). Correspondingly, the assessment of societal attitudes and perceptions regarding various ecosystem services and associated values has been receiving increasing attention (Martín-López et al., 2012; Oteros-Rozas et al., 2014; Buchel and Frantzeskaki, 2015). Significant heterogeneous perceptions towards ecosystem services generated by grasslands (Lamarque et al., 2011), agroecosystems (Oteros-Rozas et al., 2014), wetlands (Martin-Lopez et al., 2007), and nature reserves (Plieninger et al., 2013) have been found in the extant literature. Empirical evidence suggests that this heterogeneity is associated with diverging interests, awareness, knowledge and socioeconomic characteristics, such as age, gender, and residence location (Lamarque et al., 2011; Martín-López et al., 2012; Asah et al., 2014).

There is likely an ubiquitous perception that urban areas have very limited natural elements, because most pristine natural features have been eradicated as a prelude to construction during the course of urbanization (Pickett et al., 2000; Lundholm and Richardson, 2010; Pincetl, 2012) and therefore little ecological, environmental and economic value (Davies et al., 2011). Nevertheless, a burgeoning literature on ecosystem services and their values in urbanized areas, principally from an academic perspective (Escobedo et al., 2011), has appeared over the past decade (e.g., Bolund and Hunhammar, 1999; Davies et al., 2011; Gómez-Baggethun and Barton, 2013; Ahern et al., 2014; Andersson et al.,

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2014; Haase et al., 2014). However, there have been very few attempts to investigate urban dwellers' perceptions of ecosystem services and benefits provided by urban trees (e.g., Jim and Chen, 2006; Agbenyega et al., 2009; Sharp et al., 2012; Jim and Shan, 2013; Shackleton et al., 2015; Buchel and Frantzeskaki, 2015), despite the fact that urban trees have become more germane to residents' well-being due to their increasing scarcity in an urbanizing world with larger populations dwelling within the confines of cities (Jim, 1998a, 1998b; Chiesura, 2004; Heynen and Perkins, 2005). Particularly, heritage trees, a small cohort of living, vegetative assets, bring notable botanical, ecological, cultural and historical values to urban society and contribute significantly to urban resilience and sustainability (Fay, 2002; Jim, 2005a; Hall et al., 2011; Abendroth et al., 2012; Lonsdale, 2013; Chen, 2015; Shackleton et al., 2015; Wyse et al., 2015; Gerstenberg and Hofmann, 2016). Urban heritage trees are likely to harbor a wide range of endemic, rare and species, as a result of long-term human-nature interactions (Sander et al., 2003; Chen, 2015). They offer scarce habitats, food and shelter to attract and support wildlife (Fay, 2002). Hence urban heritage trees play an important role in preserving and enhancing biological diversity so as to effectively absorb disturbances and retain ecosystem functions. In addition, these biological assets are also cultural artifacts as they serve as key components of local communities' sense of place and place attachments (Reed, 2000; Jones et al., 2013), and also reflect both synchronic and diachronic cultural features (Becker and Freeman, 2009; Chen, 2015). Overall, these unique bio-cultural assets contribute to urban citizenry's well-being by providing them with ecological and social resilience in the face of climate change, and a stock of natural resources on the doorstep to be appreciated for their exceptional aesthetic, cultural, and historical merits.

Managing urban heritage trees effectively in coupled human and natural ecosystems to sustain their distinctive ecosystem services is unlikely without harnessing citizen participation in cognate practices, for which an improved understanding of how people actually perceive urban heritage trees as an intrinsic part of human well-being and what factors might affect heterogeneity in people's perceptions, would be crucial. However, empirical evidence regarding residents' perceptions of urban heritage trees' ecosystem services is lacking in the extant literature. Ameliorating this knowledge deficit would benefit not only the effective management and conservation of this bio-cultural heritage (Jim and Zhang, 2013; Rotherham, 2015), but also various natural resources across the urban-to-wildland spectrum through raising awareness of the community of rapidly expanding and densifying cities (Jones et al., 2013) in both developing and developed economies.

In an effort to better understand the heterogeneity in people's perceptions of urban heritage trees through the lens of ecosystem services (i.e., individual beliefs about the importance of urban heritage trees' benefits), this study uses Hong Kong as a case study, where a total of 481 heritage trees are facing tremendous pressures induced by relentless construction activities, urban densification and inadvertent negligence (Jim, 2005b; Jim and Zhang, 2013a, 2013b). A stratified sample of residents was interviewed to delve the heterogeneity in their perceived importance of two categories of distinctive ecosystem services provided by urban heritage trees (Chen, 2015; Rotherham, 2015): biological benefits (Fay, 2002; Green, 2002; Abendroth et al., 2012) and cultural benefits (Smardon, 1988; Jim, 2005b; Becker and Freeman, 2009). A novel statistical model, latent class factor analysis (LCFA), is employed to analyze resident perceptions expressed on ordinal scales. It is assumed that some underlying latent class variables differentiate the sampled population based on differences in six indicator variables with three representing perceptions of the biological benefits and the other three representing perceptions of the cultural benefits. The probability of belonging to a specific class is then explored with covariates describing respondents' sociodemographic and activity variables. The rest of this paper proceeds as follows. The next section describes the study area and its urban heritage trees, together with data collection and analytical method. Then, the results from the empirical analysis and associated discussion are presented. The final section summarizes the main findings and highlights the implications of this study.

2. Methodology

2.1. Hong Kong and its heritage trees

Situated at the mouth of the Pearl River and the northern rim of the South China Sea (22.12°N and 114.08°E), the Hong Kong Special Administrative Region (HKSAR) covers 1105.6 km^2 land area and accommodates 7.24 million people in 2014 (Information Services Department, HKSAR, 2015). With only 20% of the whole territory having been developed (Planning Department, HKSAR, 2015) due to its pervasively rugged terrain with slopes mostly ranging from 30 to 45 degrees (Gregory, 1964; Jim, 2005b; Jim and Zhang, 2013a), Hong Kong is an extremely compact city and one of the most densely populated places globally (Jaillon and Poon, 2008; Jim and Zhang, 2013b). Its humid sub-tropical climate is under the influence of the Asian monsoon system, which is characterized by hot – wet summers (May to August) and mild – dry winters (November to February) (Lam, 2011), with a mean annual temperature of 23.2 °C and annual rainfall of 2398 mm (Wong et al., 2002). The primary subtropical forests have all been extirpated after centuries of human activities, and plantations dominated by exotic species, such as *Acacia confusa*, *Lophostemon confertus*, *Melaleuca quinquenervia*, and *Pinus elliottii* prevail in Hong Kong's countryside (Zhuang and Corlett, 1997; Corlett, 1999; Jim and Chen, 2016).

Although Hong Kong's highly compact urban environment presents hostile conditions for tree survival and growth (Bradshaw et al., 1995; Burton, 2002; Sieghardt et al., 2005; Lundholm and Richardson, 2010; Jim and Zhang, 2013a), such as compact and polluted soil (Craul, 1999; Hawver and Bassuk, 2007; Sjöman and Nielsen, 2010), stressful microclimate (Sieghardt et al., 2005) and human abuses (Tello et al., 2005), some trees have managed to persist despite the chronical natural and anthropogenic stresses (Jim, 2005b; Jim and Zhang, 2013a, 2013b). In 2004, a total of 527 heritage trees in ulit-up areas (on un-leased government land and tourist attraction spots) from 70 species were designated by the government (Jim and Zhang, 2013a, 2013b), mainly encompassing old trees (over 100-years-old), rare and endangered species, and those of cultural and historical significance. The dominant species include *Ficus microcarpa* (Chinese banyan), *Ficus elastica* (Indian rubber tree), and *Ficus virens* (white fig) belonging to the same family Moraceae (Jim and Zhang, 2013a).

Unfortunately, the number of heritage trees has declined to 481 at present (Leisure and Cultural Services Department, 2016), due to inadequate maintenance and insufficient protection from various stakeholders. Especially, several accidents have been reported in which pedestrians were injured or even killed by falling trees (or tree parts) in the past several years (a report can be found in South China Morning Post, 2015), leading to a frustrating impression amongst policy makers, tree managers, and the general public that Hong Kong's senescent trees present risk, and should be felled and removed (South China Morning Post, 2014). Given this situation, there is no doubt that an in-depth understanding of how Hong Kong's general public perceives urban heritage trees' values is urgently needed so that individual's or community's potentially obstructionist approaches and actions can be counteracted so that