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Public willingness-to-pay for conserving urban heritage trees in Guangzhou, south China



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ABSTRACT

Heritage trees in cities represent special natural-cum-cultural assets of cities. They could contribute substantially to the quality of urban life and social welfare through the provision of an array of biological, aesthetical, environmental, and cultural benefits. The conservation of this rare and unique natural asset is a challenging endeavor in developing countries, such as China, where the intense pressures of rapid urbanization must be confronted. There is an urgent need to present these trees to the public in a way which reflects their true value to society. The present study estimated public willingness-to-pay (WTP) for the conservation of heritage trees in Guangzhou, south China by applying the contingent valuation method (CVM). The results revealed that the mean WTP was about RMB24.67 per household for common heritage tree species (with a 95% confidence interval of RMB17.46 to RMB31.88), and RMB31.26 per household for rare heritage tree species (with a 95% confidence interval of RMB21.60 to RMB40.97), respectively. Public WTP is insensitive to the rarity status of some heritage tree species, indicating that all old trees are considered as a special rare natural resource, and that there is also a general lack of publicity of the endangered status of those old trees. Analysis also showed that although people could ascribe high importance to the special cultural and biological values of urban heritage trees, it is the overall value of heritage trees, particularly the recreational value, that determines respondents' decision 'to pay' or 'not to pay' for their conservation. This recognition of the importance of various values has no impact on respondents' decision about 'how much to pay'. Income level is the only significant socioeconomic variable in WTP function, indicating that respondents' decision about 'how much to pay' is mainly based on their economic resources. Thus, it is necessary to foster public environmental awareness and responsibility in order to link individual moral obligation with conservation behavior in educational processes.

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Introduction

Cities are inordinately hostile environments for many plants (Haigh, 1980; Bradshaw et al., 1995; Jim, 1998; Hermans et al., 2003). However, a small cohort of trees has managed to find niches between the pavement slabs at the heart of cities and withstand anthropogenic and natural stresses induced by various artificial environmental forces (Jim, 2005a; Tello et al., 2005), such as compacted soil (Peper and Mori, 1999; Day et al., 2000), drought (Marsal and Girona, 1997), and polluted soil, water, and air (Bassuk and Whitlow, 1988; Clark et al., 2000; Jim, 2004). These outstanding remnant specimens are usually labeled as ancient, old-valuable, heritage, and veteran trees (Meyer, 2001; Jim, 2005b; Jim and Zhang, 2013), representing special natural-cum-cultural assets that bring a wide range of biological, historical, and cultural values to

urban society (Fay, 2002; Green, 2002; Jim, 2004, 2005a, 2005b; Nowak and Dwyer, 2007; Jim and Zhang, 2013).

Two distinctive values associated with urban heritage trees are usually the focus of traditional management and conservation: biological value and cultural (or historical) value. Ancient trees are an important biological legacy to serve as living specimens and a gene pool for enhancing biological diversity in urban landscapes (Green, 2002; Abendroth et al., 2012). In addition, they are likely to harbor a wide range of endemic, rare and threatened species, as the result of natural processes and human introduction, together with elaborate management, over many centuries of urban development (Sander et al., 2003; Jim and Zhang, 2013). Furthermore, veteran cavity trees represent scarce breeding sites and shelter for birds and many other organisms (White, 1997; Fay, 2002) and, thus, are associated with the biodiversity continuity of urban ecosystems. Despite their biological value, the heritage trees that people think of as 'natural' are also cultural artifacts (Green, 2002; Becker and Freeman, 2009). They are often woven into communities' collective memory and sense of place that links nature to people and the

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past to the present (Rival, 1998; Read, 2000; Head and Muir, 2004; Yang, 2011; Jones et al., 2013). They are artifacts reflecting both synchronic and drachronic cultural features (Smardon, 1988). Their exceptional age, uniqueness, and rarity often attract social admiration and respect (Jim, 2005a). Moreover, urban residents have commonly bestowed on them religious, spiritual, and cultural values (Smardon, 1988; Read, 2000; Jim, 2004; Liu et al., 2007). For example, *Pinus armandi* and *Quercus pannosa* are sacred trees in Naxi culture. They are strongly linked to residents' cosmological and spiritual thought and, thus, have been traditionally worshipped in Lijiang city, south China (Yang, 2011).

To echo these distinctive values accorded to urban heritage trees, various extant legislative, administrative, and managerial mechanisms have been developed to protect these living monuments and safeguard them from harm (Jim and Liu, 2000; Mynors, 2002; Jim, 2004, 2005a, 2005b; Wang and Merrick, 2013). However, it is not uncommon to find that the number of heritage trees is declining, and their health is deteriorating in many cities (Godefroid, 2001; Jim, 2005a,b). This is especially the case in developing countries, such as China, where there is a high-density compact urban form, a rapid pace of urbanization, and strong efforts to ensure internal intensification and extensive urban expansion; these factors have imposed tremendous pressures on these extraordinary trees (Jim, 2004, 2005a; Li, 2008; Li et al., 2012; Jim and Zhang, 2013). Part of the reason for this is that urban heritage trees, a key component of urban landscape resources, have historically been undervalued and underfunded (Mell et al., 2013). Their management and conservation fails to gain urbanites' support owing to narrow benefit specification, such as beauty, shade, or cooling (Dwyer et al., 1991; Weng and Yang, 2004). In particular, what urbanites value in heritage trees and how their value can be integrated into heritage tree management and conservation programs have not yet been investigated in a scientific and objective manner.

This study aims to improve our understanding of urban heritage trees' value by eliciting residents' willingness-to-pay (WTP) for a conservation program via the contingent valuation method (CVM), as well as how values vary with common and rare tree species. In this way, our goal is to uncover evidence for mobilizing community's support for heritage tree conservation and to build conservation strategies based on deep bottom-up knowledge in developing countries, where existing policies and practices are usually inadequate to protect this outstanding living heritage (Jim, 2004; Jim and Zhang, 2013). This paper reports the findings of a contingent valuation study of heritage trees in Guangzhou city, south China, and the remainder is structured as follows. The methodology, including some general background of Guangzhou's heritage trees, questionnaire and survey design, as well as statistical analysis models, is presented after Section 1. The empirical findings are then outlined, and residents' WTP with reference to various factors affecting individual WTP amounts are discussed. The conclusion is presented in the last section.

Background and methods

Heritage trees in Guangzhou city

Guangzhou city, located at the head of the Pearl River estuary, is the provincial capital of Guangdong province and a principal administrative and commercial center of south China. It has a humid subtropical climate, with an average annual temperature of 21.4–21.9°C and average annual precipitation of 1689.3–1876.5 mm (Chorography of Guangzhou, 1998). Its pristine natural vegetation is believed to be evergreen broad-leaved rain forests, with a rich assemblage exceeding 1400 floral species dominated by three botanical families: Lauraceae, Moraceae,

and Caesalpiniaceae (Hou, 1956; Huang et al., 1994; Jim, 2004). Although most primary vegetation has been eradicated during the years of agriculturalization and recent urbanization, the city still preserves a diverse urban tree stock owing to amenity-planting dating back to 130 B.C. (Jim and Liu, 2000). In particular, some trees have managed to survive for decades to centuries, and these outstanding remnant specimens have widely been regarded as heritage trees (Jim, 2004, 2005a).

Since the issuance of the Ordinance for the Protection of Old and Historical Trees in the Municipality in 1985, which requires the protection of urban trees exceeding 100-years old, rare species, and trees of special historical and commemorative significance (Jim and Liu, 2000), Guangzhou city has identified and registered a total of 1185 heritage trees, the first group of 209 trees in 1985, the second 139 trees in 1995, the third 254 trees in 1999, the fourth 314 trees in 2003, and the fifth 268 trees in 2007, respectively. The latest inventory indicated that 1107 trees were still alive by the end of 2007, of which 31 trees were over 300-years old, and 28 trees were younger than 100-years old that were either endangered species or 'famous trees' due to association with distinguished persons or events. The heritage tree population covers 58 species, overwhelmingly dominated by *Ficus microcarpa* (504 trees at 45.5%), and followed by *Litchi chinensis* (146 trees at 13.2%) and *Ficus virens* (118 trees at 10.7%). A distinctive species rarity is noticeable: there are 18 rare species (2–5 trees per species) and 24 solitary species (one tree per species). Some of these rare and solitary heritage trees are designated as endangered and protected species in the China Plan Red Data Book (Fu and Jin, 1992), such as *Glyptostrobus pensilis* (only one tree of about 230-years old), *Toona ciliata* (only one tree of about 120-years old), and *Dalbergia odorifera* (three trees of about 100-years old).

Despite various legislative and administrative measures to protect heritage trees, human activities continue to harm these elite doyens in Guangzhou city, and 78 heritage trees died in 1985–2007. Rapid urban development and renewal have witnessed internal neighborhood intensification and excessive sprawl into natural habitats in urban fringe areas (He et al., 2003), thus bringing conflicts between existing trees and new structures (Jim and Liu, 2000; Ye et al., 2008). Many infrastructure projects, such as roadwork and the construction of high-rise buildings, may cut and damage various parts of purportedly protected heritage trees, including roots, trunk, branches and foliage, which can be detrimental to tree health and growth. For example, the root system of the only *T. ciliata* was damaged due to the construction of a contiguous retaining wall (Fig. 1), and severe defoliation and a decline in tree health was observed in a field survey.

The relocation of *T. chebula* for road expansion has resulted in a severe defoliation (Fig. 2).

The pressures of competition with other grey infrastructures have been exacerbated. In general, insufficient budgets have been allocated to the protection of heritage trees, which led to improper and especially inadequate management and protection practices. The plight of heritage trees in Guangzhou city demands enlightened and urgent attention toward augmenting protection, funding, and community support. Budgetary constraints facing the local government regarding the provision of comprehensive maintenance and conservation have fueled interest in understanding whether the public could recognize the value of urban heritage trees associated with their ecological and cultural significance, and what is their willingness-to-pay (WTP) to preserve these natural-cum-cultural heritage for future generations.

Design of survey instrument

A contingent valuation survey was developed to assess the WTP of households for heritage tree conservation in Guangzhou. The

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