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Research Paper

Urban green space, public health, and environmental justice: The challenge of making cities 'just green enough'

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HIGHLIGHTS

- Urban green space promotes physical activity and public health.
- Many US minority communities lack green space access, an environmental injustice.
- US and Chinese cities have developed innovative ways to create new green space.
- Urban greening can, however, create paradoxical effects such as gentrification.
- Urban green space projects need more integrative sustainability policies to protect communities.

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ABSTRACT

Urban green space, such as parks, forests, green roofs, streams, and community gardens, provides critical ecosystem services. Green space also promotes physical activity, psychological well-being, and the general public health of urban residents. This paper reviews the Anglo-American literature on urban green space, especially parks, and compares efforts to green US and Chinese cities. Most studies reveal that the distribution of such space often disproportionately benefits predominantly White and more affluent communities. Access to green space is therefore increasingly recognized as an environmental justice issue. Many US cities have implemented strategies to increase the supply of urban green space, especially in park-poor neighborhoods. Strategies include greening of remnant urban land and reuse of obsolete or underutilized transportation infrastructure. Similar strategies are being employed in Chinese cities where there is more state control of land supply but similar market incentives for urban greening. In both contexts, however, urban green space strategies may be paradoxical: while the creation of new green space to address environmental justice problems can make neighborhoods healthier and more esthetically attractive, it also can increase housing costs and property values. Ultimately, this can lead to gentrification and a displacement of the very residents the green space strategies were designed to benefit. Urban planners, designers, and ecologists, therefore, need to focus on urban green space strategies that are 'just green enough' and that explicitly protect social as well as ecological sustainability.

1. Introduction

The world's cities are becoming increasingly congested and polluted (Blanco et al., 2009). Urban green space provides a wide range of ecosystem services that could help combat many urban ills and improve life for city dwellers—especially their health. Such green space is diverse, varying in size, vegetation cover, species richness, environmental quality, proximity to public transport, facilities, and services (Dahmann, Wolch, Joassart-Marcelli, Reynolds, & Jerret, 2010; Fuller & Gaston, 2009; Sister, Wolch, & Wilson, 2010). Public green space includes parks and reserves, sporting fields, riparian areas like stream and river banks, greenways and trails, community gardens, street trees, and nature conservation areas, as well as less conventional spaces such as green walls, green alleyways, and cemeteries (Roy, Byrne, & Pickering, 2012). Private green space includes private backyards, communal grounds of apartment buildings, and corporate campuses.

Ecosystem services provided by urban green space not only support the ecological integrity of cities, but can also protect the

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public health of urban populations. Green space may filter air, remove pollution, attenuate noise, cool temperatures, infiltrate storm water, and replenish groundwater; moreover, it can provide food (Escobedo, Kroeger, & Wagner, 2011; Groenewegen, van den Berg, de Vries, & Verheij, 2006). For example, trees in urban areas may reduce air pollution by absorbing certain airborne pollutants from the atmosphere (Nowak, Crane, & Stevens, 2006). Green cover and urban forests can also moderate temperatures by providing shade and cooling an area, thus helping reduce the risk of heat-related illnesses for city dwellers (Cummins & Jackson, 2001; Nowak et al., 1998).

But within cities, green space is not always equitably distributed. Access is often highly stratified based on income, ethno-racial characteristics, age, gender, (dis)ability, and other axes of difference (Byrne, Wolch, & Zhang, 2009; McConnachie & Shackleton, 2010). Over the past two decades, the uneven accessibility of urban green space has become recognized as an environmental justice issue as awareness of its importance to public health has become recognized (Dai, 2011; Jennings, Johnson Gaither, & Gragg, 2012). The literature has focused on how to measure access to urban green space, primarily parks; the relative access of socio-demographics to these spaces; and how lack of access affects public health. Most has originated from the United States, the United Kingdom and Australia.

The reasons why green space is differentially distributed within the urban landscape are varied, including the philosophy of park design, history of land development, evolving ideas about leisure and recreation, and histories of class and ethno-racial inequality and state oppression (Byrne, 2012; Byrne & Wolch, 2009). Often explanations are interrelated and mutually reinforcing. For example, US histories of property development are intertwined with histories of ethno-racial oppressions, philosophies of park design and land-use systems.

In the United States, people of color and low-income earners typically occupy the urban core and/or low-income inner ring suburbs where green space is either scarce or poorly maintained. Wealthier households often reside on the suburban periphery where green space is abundant, well-serviced, and well-maintained (Heynen, Perkins, & Roy, 2006). This environmental injustice has become a planning priority, leading to parkland acquisition programs and diverse strategies to deploy underutilized urban land for additional green space.

Redressing park-poverty in communities of color and/or low income households can, however, create an urban green space paradox. As more green space comes on line, it can improve attractiveness and public health, making neighborhoods more desirable. In turn, housing costs can rise. Such housing cost escalation can potentially lead to gentrification: the displacement and/or exclusion of the very residents the green space was meant to benefit. In turn, residents may face higher rents and thus become precariously housed, while those who are actually displaced may be forced to leave their communities, ending up in less desirable neighborhoods with similar park-poverty problems. This paradox has negative public health implications, not only because of continued park poverty but also because displacement and precarious housing status themselves have negative public health implications (Bentley, Baker, & Mason, 2012; Centers for Disease Control, 2011).

This paper offers a synthesis of Anglo-American research on the role of urban green space in shaping public health and environmental justice. This literature has focused on urban parks, and to a lesser degree, green cover. Other types of green space (e.g., green roofs, green walls) have yet to be systematically studied. We first review scholarship on urban green space and public health, noting that many studies demonstrate the importance of green space access for health and wellbeing. Then, we review studies of urban green space and environmental justice (Section 3), finding evidence that access to urban park resources is differentiated by class and ethno-racial dimensions, warranting intervention. In Section 4, we consider these health and justice findings as they relate to the rapidly urbanizing Chinese city of Hangzhou, and assess whether innovative efforts to expand inner-city green space there have been successful. We identify some similarities, but also significant differences. In the final section, we evaluate potential interventions for urban greening, such as adaptive reuse of infrastructure, mindful of lessons from China. Following Curran and Hamilton (2012), we suggest that a primary challenge is to develop strategies that are 'just green enough.' That is, to reap the public health benefits of improved access to urban green space while avoiding the urban green space paradox.

2. Public health benefits of urban green space

Most research on urban green space and health has focused on parks, with studies also examining green cover (Bedimo-Rung, Mowen, & Cohen, 2005; Kuo, Sullivan, Coley, & Brunson, 1998). Lack of park access has been linked to mortality (Coutts, Horner, & Chapin, 2010). Green cover has also been shown to protect health (Villeneuve et al., 2012). Additionally, parks often serve as sites of physical activity, which is associated with enhanced health and reduced risk for all-cause mortality and many chronic diseases (Anon, 1996; Barton & Pretty, 2010; Bush et al., 2007; Casey et al., 2008; Grahn & Stigsdotter, 2010; Hartig, 2008; Kuo, 2001; Woodcock et al., 2009). Indeed, a large number of studies demonstrate linkages between park proximity and physical activity (for example, Brownson, Baker, Housemann, Brennan, & Bacak, 2001; Cohen et al., 2006, 2007; Diez Roux et al., 2007; Evenson, Wen, Hillier and Cohen, 2013; Gordon-Larsen, Nelson, Page, & Popkin, 2006; McCormack, Rock, Toohey, & Hignell, 2010; Sallis, Floyd, Rodriguez, & Saelens, 2012).

Particular attention has focused on parks and the obesity epidemic (Ogden, Carroll & Flegal, 2008). Obesity can be detrimental to children's health (Dietz, 1998), and increase the probability of adult obesity (Freedman, Mei, Srinivasan, Berenson & Dietz, 2007). While genetic factors probably contribute (Stunkard, 1991), rapid increases in obesity suggest that individual behavior patterns, including low levels of physical activity, appear to powerfully influence obesity trends (Hill & Peters, 1998). Children with more access to parks and recreational facilities are more active than children with less access, and most results for adults are similar (Diez Roux et al., 2007; Timperio, Salmon, Telford & Crawford, 2005).

For example, Giles-Corti et al. (2005) outlined the importance of attractiveness and size of open space. A series of studies in Perth, Australia (Giles-Corti & Donovan, 2002; Giles-Corti, Macintyre, Clarkson, Pikora, & Donovan, 2003), using cross-sectional surveys and data on environmental facilities, found that parks were more likely to encourage physical activity if they were perceived as esthetically pleasing (minor traffic, sidewalks, trees, retail shops). Veitch, Ball, Crawford, Abbott, & Salmon (2012) studied park use as well as physical activity in Victoria, Australia, before/after improvements, finding significant increases in park use following improvements.

Curiously, public recreation has seldom been studied in regard to physical activity and obesity. Dahmann et al. (2010), however, in a cross-sectional study, audited recreation programs from southern California municipalities. Findings indicated that areas with higher population density, lower incomes, and a greater share of minority residents had inferior access to public recreational programming.

Recent studies show that both parks and recreational programs are important to the development of obesity. Wolch et al. (2011) controlled for a wide range of built environment factors—including the foodscape (Leal & Chaix, 2010), pollution exposure and traffic

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density (Jerrett et al., 2009), and social conditions, such as poverty, unemployment, and crime—to assess how proximity to parks and recreational resources affects the development of childhood obesity. Park access and especially recreational program access were significantly related to the development of obesity.

In addition, psychological well-being is empirically linked to urban parks and green space (Ernstson, 2012). A park experience has been shown to reduce stress (Ulrich, 1981; Ulrich et al., 1991; Woo et al., 2009), and green space can afford urban residents opportunities to encounter plants and animals as well as opportunities to recuperate or experience solitude (Fuller, Irvine, Devine-Wright, Warren, & Gaston, 2007). Park visits can also rejuvenate residents, enhance contemplation, and provide a sense of peace and tranquility (Kaplan and Kaplan, 2003; Song, Gee, Fan, & Takeuchi, 2007).

Physical activity in green space—or green exercise—is also important to mental health. Barton and Pretty (2010), for example, conducted a meta-analysis of UK studies, showing that there were significant impacts of green exercise on several measures of mood and self-esteem. Another meta-analysis (Lee and Maheswaran, 2011) found linkages between various measures of psychological health and urban green space (Maas et al., 2009; Ohta, Mizoue, Mishima, & Ikeda, 2007). In a major Dutch study Van den Berg, Maas, Verheij, & Groenewegen (2010) showed that respondents with more green space near their homes were less affected by a stressful life event than those with a low green space access, suggesting that green space buffers stress. Also as a locus of social interaction urban parks can increase perceptions of safety and belonging (Kuo et al., 1998).

Louv (2005) contends that children who lack access to urban green space suffer from a wide range of behavioral problems. Fuller et al. (2007) in Sheffield, England, found positive associations between species richness and psychological well-being, and Faber-Taylor, Kuo, and Sullivan (2001) found that children with attention deficit disorder who were active in green space had reduced symptoms. More generally, several studies find that interaction with nature and animals is important to child development and well-being (Kahn & Kellert, 2002).

While research has generally focused on the health benefits of parks and other green space, there may be health risks too. These include air pollution exposure near parks and safety concerns in parks that are located in heavy traffic areas. Active transportation such as walking and bicycling, by contrast, incorporates physical activity into daily routes, reduces obesity (Giles-Corti et al., 2003; Wolch et al., 2010), and alleviates automobile congestion and traffic-related air and noise pollution (Cavill & Davis, 2007). Low-income communities of color, however, already have relative high rates of active transport (Houston, Wu, Ong, & Winer, 2004) and may experience adverse health effects if strategies promoting active travel are poorly implemented (de Nazelle, Rodriguez & Crawford-Brown, 2009). For example, if planning interventions increase walking and cycling in polluted neighborhoods, without commensurate efforts to reduce levels of air pollution, they risk also increasing low-income residents' exposure to pollution. A study by Su, Jerrett, de Nazelle, and Wolch (2011) found that park-adjacent neighborhoods in the Los Angeles region had higher pollution concentrations, especially in low income and minority communities.

3. Environmental injustice in access to urban green space

Given the links between green space access and health, an important question is whether access to urban green space—and its health promoting and/or protective effects—is distributed in ways that disproportionately advantage or disadvantage people on the basis of race, ethnicity or class?

Despite a growing literature, there is no consensus among scholars about how to measure green space access. Most studies have used Geographic Information Systems (GIS) to measure accessibility (Oh and Jeong, 2007; Sister et al., 2010; Talen, 1997). Metrics include presence vs. absence of a park or recreation facility near the home, density of facilities, or total park acreage within a given radius of home (Mota et al., 2005; Norman et al., 2006; Roenmich et al., 2006; Zakarian, Hovel, Hofstetter, Sallis, & Keating, 1994).

Geographic access alone may not fully capture the impact of parks on physical activity or obesity. Usage may depend on park characteristics and programs offered. Simple GIS measures can also fail to account for potential congestion of park space, which may deter use. For example, Sister et al. (2010) allocated all residents to their nearest park, creating "park service areas" that could be compared in terms of potential congestion, demographics, and socioeconomic characteristics. Park congestion was more acute in low-income and minority neighborhoods.

A challenge in access measurement is that green space is notoriously heterogeneous. Parks differ in terms of size, quality, range of facilities, availability of organized recreation, or perceptions of safety among actual or potential users. They are designed to serve diverse communities and wide-ranging recreational needs. Parks also have reputations reflecting their use, repute, upkeep, and design quality (Byrne & Wolch, 2009). Such heterogeneity means compliance with uniform national standards for urban park space provision in the United States is difficult (Wilkinson, 1985). These standards may even negatively impact some urban residents, prescribing blanket solutions where locally specific interventions are needed.

Regardless of measurement strategy, there is abundant evidence of environmental injustice in the distribution of urban green space. A variety of other studies show that racial/ethnic minorities and low-income people have less access to green space, parks, or recreational programs than those who are White or more affluent (Abercrombie et al., 2008; Dahmann et al., 2010; Jennings et al., 2012; Johnson-Gaither, 2011; Landry & Chakraborty, 2009; Leslie, Cerin, & Kremer, 2010; Sister et al., 2010; Wolch, Wilson, & Fehrenbach, 2005). In addition, studies of public and nonprofit funding for urban parks and recreation indicate this also follows race/class contours, with low-income communities of color having far less to spend on parks and recreation and having less nonprofit resources as well (Joassart-Marcelli, 2010; Joassart-Marcelli, Wolch, & Salim, 2011).

Some studies have found more complex relationships between park access and race/ethnicity or socioeconomic status. Boone, Buckley, Grove, & Sister (2009), studying Baltimore, found that although Blacks were more likely than Whites to live within walking distance of a park, Whites had access to more park acres. Consequently, there was more park congestion in the park service areas serving Blacks than in those serving Whites. Also, not all poor people or people of color live in inner cities; numerically, more poor people now live in suburbs (Kneebone & Berube, 2013). But the suburbanization of poverty is largely a result of increases in inner-ring suburban poverty due to deindustrialization, job loss, White flight, and inner city gentrification (Cooke, 2010). Such communities typically lack fiscal capacity and thus may have poorly maintained parks and minimal recreation programs (Dahmann et al., 2010). In some metropolitan regions, densification of inner suburban areas due to crowding also means that there may be pressure on park space (Sister et al., 2010).

Environmental injustice also emerges from studies of why parks may go unused. Scholars have generally attributed park (non)use, to socio-cultural (e.g., poverty, cultural preferences) and socio-spatial determinants (e.g., travel distance, park features). One reason is that

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a given park space may be perceived as unsafe or "belonging" to another group in the community (Brownlow, 2006; Burgess, 1996; Gobster, 1998; Stodolska, Shinew, Acevedo, & Izenstark, 2011). Byrne's (2012) work involving focus groups with low-income Latinos in Los Angeles illustrates how ethno-racial formations, histories of segregated park systems, and land-use regulation can circumscribe park access and use.

Together, these findings document environmental injustice associated with access to urban green space, warranting intervention. The dimensions of such justice challenges will vary from place to place, but are apt to have long-term implications for health and well-being.

We now turn to urban planning and landscape interventions being tested in both US and Chinese cities to see how experiments in one place can inform others. China is undergoing unprecedented rates of urbanization. Racially homogeneous, China has disparities in income and ethnic minority status that negatively affect health. Chinese experiences with retrofitting urban green space can offer important lessons to cities of the Global North.

4. Approaches to retrofitting urban green space: examples from Hangzhou, China

The scale of internal migration, urban growth, and impacts of urban transformation in China dwarf experiences elsewhere (Zhu, 2012). Between 1980 and 2009 the urban population swelled by 431 million—more than the population of the United States. Accompanying these trends is widespread environmental pollution (Gong et al., 2012) as well as more sedentary lifestyles and changing diets, and rising prevalence obesity, diabetes and kidney disease (Gong et al., 2012).

Environmental justice is an emergent problem in China, with environmental impacts and well-being increasingly distributed by income and possibly by ethnicity (Quan, 2001; Smyth, Mishra, & Qian, 2008; Zeng and Gu, 2007). Pollution impacts, hazardous jobs, and poor quality housing are disproportionately concentrated among lower-income earners, many without permanent residency under China's *hukou* registration system and thus not entitled to health, education, and other benefits in the city (Ma, 2010). Moreover, citizen participation in decision-making is limited, as are avenues for raising formal complaints about environmental protection and management (Li, Liu, & Li, 2012); residents also fear that complaints will bring reprisals or persecution (Brajer, Mead, & Xiao, 2010).

Access to green space is also an environmental justice issue in China, due to historical patterns of urban development, high residential densities, and explosive rates of urbanization. The Western ideal of the park is relatively new to China (Shi, 1998). During the early twentieth century, public parks were created in Beijing and Shanghai, but largely reserved for Europeans, wealthy merchants, and dignitaries. Commoners were actively excluded (Bickers & Wasserstrom, 1995).

Park-planning has lagged behind real estate development. Green space standards are enshrined within Chinese planning codes, but are difficult to enforce. Limited research on green space access in China has been translated for English-language journals, but those published reveal that ecological functions of green space are poorly understood, and demand for green space significantly outstrips supply. A recent study of Shanghai found that many residents lack access to parks, and that entire areas of the city have no formal green spaces (Yin and Xu, 2009b). While in the US the national median green space ratio is 50.18 m^2 per capita, the average is just 6.52 m^2 per capita in China (Trust for Public Land, 2011; Wang, 2009), despite more generous planning standards (Yin and Xu, 2009a).

4.1. The example of Hangzhou

Hangzhou is the capital of Zhejiang Province, located approximately 200 km southeast of Shanghai (see Fig. 1). With about 6 million residents, it is one of China's oldest cities (Altenburger & Chu, 2010). Rapid urbanization has consumed its agricultural hinterlands, and is profoundly impacting the city's environmental quality (Spiekermann et al., 2013). Most days are blanketed in air pollution (Meng et al., 2012). The city's annual average temperatures are also the second-hottest in China, exacerbated by its impervious urban development (Shen, Chow, & Darkwa, 2013).

What sets Hangzhou apart from other Chinese cities, though, are its innovative efforts to address the declining environmental quality by restoring lost green space (Qin-Tong, 2011; Wu, Zhao, Ren, Tian, & Shen, 2012). These efforts include the demolition of factories for parks, retrofitting green space alongside formerly dilapidated canals, underneath and alongside main roads and railway lines, and mass tree planting along city streets.

Hangzhou is recognized throughout China as a Garden City and renowned for its tree-lined streets, scenic West Lake National Park, and for the nation's first urban wetland park—the XiXi Wetlands (about three times larger than New York's Central Park). "Garden City" is an official designation in China, meaning that a city meets certain national standards for forest cover, amount of green space, and provision of parks—as determined through remote sensing. Since 1992, more than 600 cities have met these standards, but Hangzhou is exceptional (Wu, Ye, Qi, Zhang, 2012).

Due to its ambitious urban greening program, officially Hangzhou now has 166.5 km^2 of green space (about 40% of the city area; Fig. 2). In 2012, urban green space increased by 14.4 million m^2; in 2013, the target is for an additional 13 million m^2. The official ratio of green space is about 15 m^2 per capita, and over 90% of the city's population reportedly has easy access (Sang Lijie et al., 2013). Large-scale reforestation has preserved and integrated historic sites such as the pagoda of the City God adjacent to Wushan Plaza into new green and open space precincts.

But official statistics belie the nature of green space in Hangzhou. Many parks are small and contain few facilities. They may be esthetically pleasing, but most are not suited to active recreation. Parks in Hangzhou generally fit Western description of 'pleasure gardens' (Chen, Bao, & Zhu, 2009), many elaborately landscaped for passive recreation only (Chen et al., 2009). Miao (2011) describes such parks as 'window dressing' which seldom allow active use. Many have extensive pavements to cope with high use volumes. Residential densities in the city's core districts are between 16,000 and 19,000 persons per km^2 (Spiekermann et al., 2013). Often, green space in these districts is located close to main roads, increasing users' exposure to air pollution and making it difficult to escape traffic noise (Sun et al., 2013). And evidence suggests differences in access to green space associated with socio-demographic characteristics of the population (Lv et al., 2011).

Hangzhou's ambitious urban greening hinges upon activating neglected spaces such as land adjacent to and underneath freeways, alongside railway lines (see Fig. 3), along the banks of canals that transect the older urban core, and on former factory sites (Yang, Chang, Xu, Peng, & Ge, 2008). The goals are to reduce heat island impacts, lessen storm-water and flooding though evaporation, intercept pollutants, and reduce wind speed (Chen, Bao, & Zhu, 2006). Preliminary research suggests urban greening is paying dividends, with temperature reductions of between 4° and 6° in some parts of the city (Wenting, Yi, & Hengyu, 2012).

However, although green space health benefits have not been studied extensively for Hangzhou, some new urban greening efforts may be problematic. Parks alongside freeways and rail corridors may expose users to air pollutants. A study by Byrne (2013) revealed under-provision of active recreation space in

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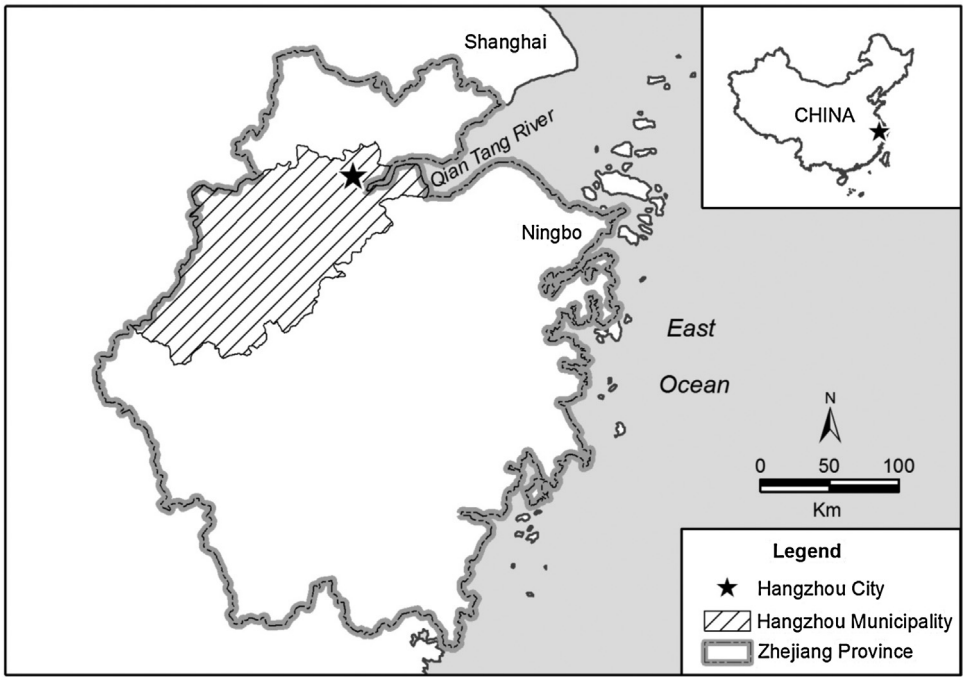

Fig. 1. Location of Hangzhou, China.

Source: J. Byrne.

inner city districts in Hangzhou, with limited outdoor play spaces for children and teenagers. Existing inner city green space is often congested; when temperatures are high, it is often shoulder to shoulder in many of the city's parks. Although many new residential communities incorporate green courtyard gardens, the overall amount of green space is very low. Some areas lack access to urban green space—especially older areas awaiting redevelopment and peripheral communities (Sang Lijie et al., 2013).

In addition, new studies suggest that urban greening efforts may also be inflating property values (Chen, 2012), potentially leading to gentrification and thus displacing lower-income earners. Even the smallest green space embellishments may drive up property prices in the urban core, where densities are highest, parks are fewer, and temperatures are the hottest.

Hangzhou may thus face park-related environmental justice problems. Yet efforts to create more green space may bring unwelcome consequences in the form of the green space paradox.

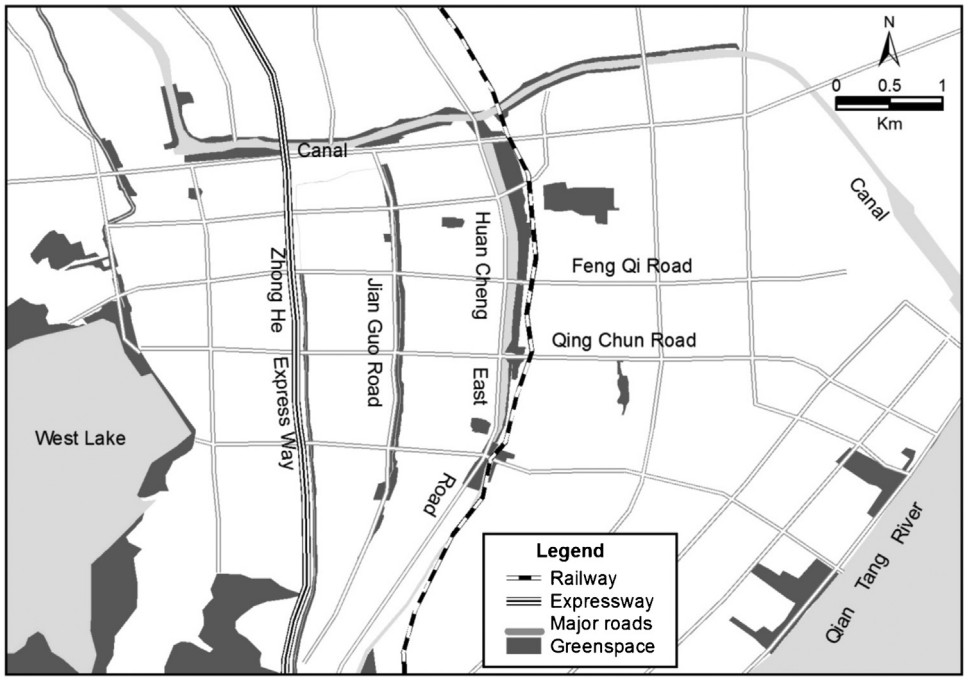

Fig. 2. Distribution of Green space, Hangzhou, China.

Source: J. Byrne.

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Fig. 3. Green space retrofits, Hangzhou, China.

Source: J. Byrne.

5. Conclusion: the paradox of urban green space

This paper has highlighted the importance of urban green space for public health. Parks and open space and other forms of green space can also provide essential services that are critical to both urban ecological functioning and integrity. Urban green space is also an environmental justice issue, given that in many cities, low-income neighborhoods and communities of color—places where public health challenges tend to be the most critical—often have relatively poor access to safe and well-maintained parks and other types of open space.

The imperative to address such environmental injustices and related public health disparities, as well as enhance urban ecologies, has led planners to focus on both traditional parkland acquisition programs and innovative strategies for expanding green space resources. In addition, community-based organizations, often aided by environmental groups, are refocusing urban brownfield remediation projects on urban green space to address public health and environmental justice concerns (Barnett, 2001). These strategies do not represent a re-orientation toward problematic green-space types (e.g., parks beneath freeways), rather they highlight possibilities for adaptive re-use of infrastructure, provided that health standards are not compromised.

There is a range of possibilities opened up through the adaptive use of obsolete or underused urban infrastructure, such as rail corridors, underutilized back alleys, urban streets, abandoned transport or utility corridors, and remediated brownfields. Planners in dozens of cities across the United States, for instance, are transforming back alleys into green infrastructure for walking and biking, informal play and exercise, and social interaction, while offering a distributed strategy for urban runoff infiltration and habitat provision (Fig. 4; Newell et al., 2013; Wolch et al., 2011). These green spaces are unlikely to offer organized recreational activities, but they can be equipped with micro-gyms shown to increase physical activity and energy expenditures (Cohen et al., 2012).

Perhaps the most famous example of using obsolete infrastructure is New York's High Line (Fig. 5), now being replicated in many US cities as well as at least one Chinese city. The High Line was built on the remains of an abandoned elevated train line spur, originally designed to cut through blocks rather than follow the street, allowing freight to be easily delivered to factories and other businesses. Rendered obsolete by the 1980s, it was slated for demolition but rescued by local activists and redesigned as an aerial greenway. The High Line has become one of the most popular destinations in the city, attracting millions of people each year, along with a variety of birds, insects, and other small animals.

Yet like other urban sustainability approaches, such urban green space strategies may have paradoxical results (Krueger & Gibbs, 2007). If they are successful from the perspective of urban residents and businesses, they may ultimately exclude those whose need for access is most acute. By simultaneously making older and typically low-income and/or industrial areas of existing cities more livable and attractive, urban greening projects can set off rounds of gentrification, dramatically altering housing opportunities and the commercial/retail infrastructure that supports lower income communities (Zukin et al., 2009). This paradoxical effect has been variously termed ecological gentrification (Dooling, 2009), green gentrification (Gould & Lewis, 2012), environmental gentrification (Checker, 2011) or eco-gentrification (Patrick, 2011).

This dynamic is not new, nor is it unique to western cities. Many major park projects of the past, including Central Park, were overtly designed to increase land values and open up development opportunities (Cranz, 1982), and this pattern is shaping urban areas in China and other parts of Asia (He, 2007; Lim et al., 2013). But across locales, developers, planners, and urban environmental managers now harness the language of sustainability, green consumption, and ecology to facilitate green space provision and gentrification (Quastel, 2009).

The same land market dynamics apply, even when projects are ecologically oriented or less grand (Brander & Koetse, 2011;

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Fig. 4. Proposed Avalon Green Alley Network, South Los Angeles, 2012.
Image: Trust for Public Land. From Newell et al. (2013).

Conway, Li, Wolch, Kahle, & Jerrett, 2010; Heckert & Mennis, 2012; Nicholls & Crompton, 2005; Saphores and Li, 2012). Similarly, although hazardous waste cleanup can proceed without changes in property values (Eckerd, 2011), brownfield redevelopment as green space can raise property values, forcing poor residents out, only to resettle in communities with worse environmental quality (Dale & Newman, 2009; De Sousa, Wu, & Westphal, 2009; Eckerd, 2011; Essoka, 2010; Pearsall, 2010). Poignantly, Dooling (2009) recounts efforts to improve ecological function along riparian zones in Seattle, which were proceeded by removing homeless people who lived in these areas, along with the services designed to assist them. Privileging natural processes and ecological health, while

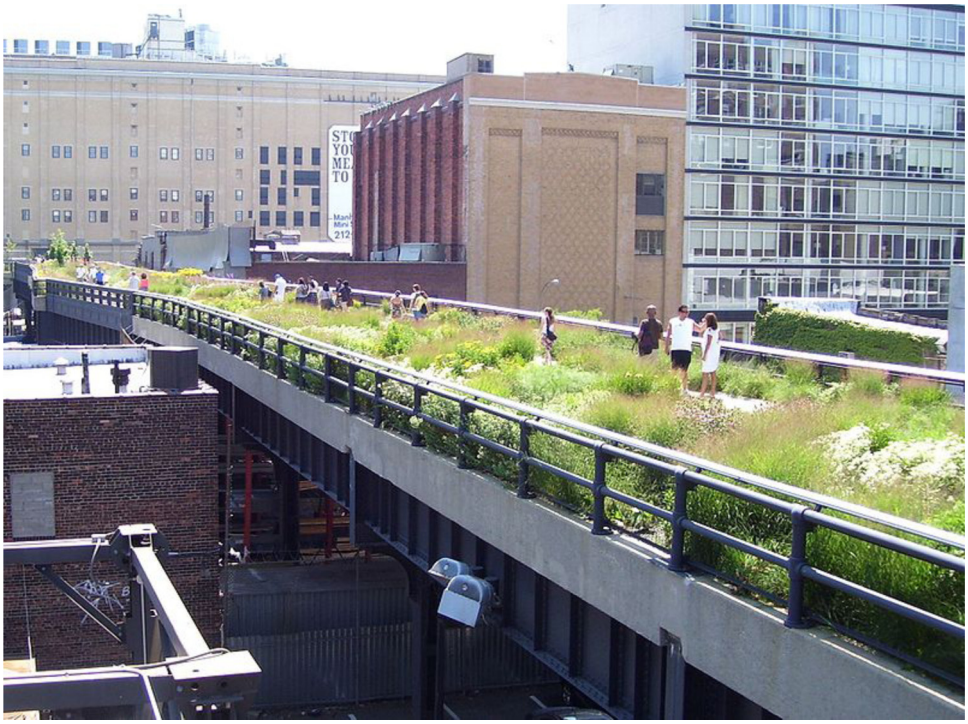

Fig. 5. High Line, 20th St. Looking Downtown, 2010.
Photo: Beyond My Ken.

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invoking environment ethics, relegated social justice issues to the sidelines.

Eco-gentrification can arise even when the primary motive in urban green space provision is addressing environmental injustices in its distribution. For example, Checker's (2011) analysis of park development in Harlem found that efforts to address environmental justice issues linked to park availability stalled because residents recognized that park development was primarily a strategy for real estate development and gentrification. Thus environmental remediation in older neighborhoods, and the creation of new green spaces can, as Curran and Hamilton (2012) point out, literally "naturalize" the disappearance of working-class communities, as such improved neighborhoods become targets for new and more upscale development.

Perhaps the most widely recognized US example of this paradox is the High Line. By linking the project to urban sustainability, advocates enjoined a discourse of ecological modernization in the service of increasing property values (Patrick, 2011); indeed the New York City Economic Development Corporation (2011) found that between 2003 and 2011, nearby property values had increased 103% despite the deep recession, and $2 billion had been invested in related property development (Brisman, 2012; McGeehan, 2011). In Asia, a parallel example is the state-led restoration of the Cheonggyecheon Waterway in Seoul. This project, advocated on ecological grounds, has led to increases in property values and the conversion of industrial land uses to commercial uses serving more affluent stakeholders (Lim et al., 2013).

How, then, can urban ecologists, planners, and designers address this green space paradox?

A promising approach is to design interventions that are 'just green enough' (Curran & Hamilton, 2012). In their case study of Greenpoint, a community in Brooklyn, Curran and Hamilton found that working-class residents and gentrifiers collaborated to demand environmental cleanup strategies that allowed for continued industrial uses and preservation of blue-collar work, and explicitly avoided what they term the "parks, cafes, and a riverwalk" model of a green city (p. 1028). The "just green enough" strategy targeted toxic creek cleanup and green space development along the creek near the existing working-class population and industrial land users, to address both environmental and social justice, and to avoid new rounds of speculative development. Similarly, Pearsall (2010) studied three New York neighborhoods, concluding that environmental gentrification is multidimensional, context-specific, and cross-scale; in certain local contexts, residents can become resilient, resist displacement, and remain in communities whose environments have improved as a result of public and private investments.

The 'just green enough' strategy depends on the willingness of planners and local stakeholders to design green space projects that are explicitly shaped by community concerns, needs, and desires rather than either conventional urban design formulae or ecological restoration approaches. Replacing these market-driven or ecological approaches with 'just green enough' strategies is especially challenging, typically requiring community activism. Those efforts, however, can help protect lower income neighborhoods. For instance, Newman (2011) found that local non-profits in Toronto encouraged planners to move away from re-wilding approaches to restoration, in favor of emphasizing landscapes that can also serve as nodes for urban agriculture and community garden spaces. In this way, restoration projects are more connected to local concerns about food security, job creation, and human health.

In addition, planners aiming for 'just green enough' solutions can promote green space interventions that are small-scale and in scattered sites, rather than grander civic green space projects that geographically concentrate resources and kick-start rounds of gentrification. Schauman and Salisbury (1998), for example, trace the history of urban reuse from focusing on very large, complex, and extremely degraded sites, such as abandoned mines or oil refineries, to its present focus on weaving natural function into many small, underutilized sites. Refocusing on small-scale interventions, they argue, has the benefit of more evenly distributing access to nature for urban residents rather than creating a focal point for property development strategies.

Such bottom-up urban green space strategies can be supported by anti-gentrification policies. These include provision of affordable housing and housing trust funds. Also, rent stabilization programs can reduce absentee landlordism, while financial incentives for homeownership and shared equity housing projects can allow existing residents to have a stake in an improving neighborhood. Protections can also be offered to local businesses through requirements for controls on rents, set-asides for local ownership and employment, and measures to maintain industrial uses (Jerzyk, 2009; Kennedy & Leonard, 2001; Pendall, Nelson, Dawkins & Knapp 2005).

Being 'just green enough' demands a careful balancing act. It involves collaborations between local government and disparate community groups, and a willingness of local stakeholders to contest powerful real estate interests and mainstream environmental advocates. But the active involvement of urban planners, designers, and ecologists is also essential, to articulate strategies for urban green space that explicitly advance public health, environmental equity, and social justice in urban communities.

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