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Individual households and their trees: Fine-scale characteristics shaping urban forests

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ABSTRACT

In urban areas, the pattern of trees is often a result of municipal policy, built form, neighborhood socioeconomic conditions, and the actions of local actors. Recent research has focused on the role of neighborhood socioeconomics, and begun to explore the underlying causes of uneven distributions of urban forests associated with different socioeconomic groups. To date, little work has explored property-level tree conditions in relation to disaggregated household characteristics and actions, yet the household is the scale where most decisions about residential tree planting and care are made. This study examines the role of property-level built conditions, household socioeconomics, and residents' actions and attitudes in relation to property-level canopy cover and tree density. The study area is four neighborhoods in the City of Mississauga (ON, Canada). Regression analyses were conducted to explore significant variables related to the two tree measures for all properties together and separately by neighborhood. The results indicate that property conditions and residents actions are more important in relation to tree variations than socioeconomic factors. Additionally, several significant factors have opposite relationships with percent canopy cover and tree density. These results highlight the need to consider property-level built conditions, residents' actions, and multiple measures of the urban forest to better understand the patterns of trees in cities.

Introduction

Urban forests are vital sources of ecological services that keep our cities healthy, safe and vibrant (McPherson et al., 2005; Tyrväinen et al., 2005). In many cities, trees are unevenly distributed, raising concerns about unequal access to urban forest related benefits by city dwellers. The distribution of the urban forest is determined by a number of factors, with humans playing an important role. More specifically, government policy, neighborhood conditions, community groups, and individual actors all contribute to the spatial configuration of urban trees (Alberti, 2005; Grove et al., 2006; Conway and Urbani, 2007). Recent research has focused on exploring the role of neighborhood conditions – including age of development, built form, socioeconomic status and ethnic composition of residents – on urban forest patterns (Heynen and Lindsey, 2003; Grove et al., 2006; Landry and Chakraborty, 2009). To date, little work has examined these relationships at the finer-scale of the household, yet the majority of urban trees typically fall on private residential property and the individual household is the scale where most decisions about residential trees are made.

Along with a neighborhood focus, most studies adopt percent canopy cover to represent the urban forest. While percent canopy cover is a useful measure, as it is related to many of the services provided by urban forests, recent research suggests it is highly dependent on the age of development and past conditions (Troy et al., 2007; Luck et al., 2009; Boone et al., 2010). Tree density is an alternative measure that can help understand built and social factors correlated with urban forest patterns. It primarily differs from percent canopy cover in the way it equally includes younger trees, which may not significantly contribute to canopy cover but are still a vital part of the urban forest structure. Moreover, tree density can be modified by residents over short-time periods through planting and removal decisions; while canopy cover can be quickly decreased, through the removal of large trees, residents cannot significantly increase it over short-time periods. To date, very few studies have examined tree density correlates (for an exception, see Pedlowski et al., 2002), but recent research suggests that it captures an aspect of the urban forest that has a different relationship with socioeconomic conditions than percent canopy cover (Conway and Bourne, 2013).

The goal of this study is to shed light on fine-scale factors associated with urban residential tree patterns. Specifically, we explored

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(1) the relative role of property-level built characteristics, household socioeconomic conditions, and residents' actions and attitudes and (2) the ways these relationships vary between different tree measures. This was accomplished by examining disaggregate data reflecting property and household characteristics related to residential property-level canopy cover and tree density. The study area includes residential properties in four neighborhoods in the City of Mississauga (ON, Canada). Significant property and household characteristics, collected primarily from a survey of residents, were identified through regression analysis. The following sections outline recent research examining neighborhood-level correlates of the urban forest, our methods and results, and the broader implications of the household-level relationships present in the study area.

Neighborhood correlates

Neighborhood-level built, economic and social factors are frequently related to the extent and condition of urban forests across North America (Alberti, 2005). In terms of neighborhood built characteristics, age of development is a strong predictor of tree cover, with 40–50 year old neighborhoods often having the most canopy due to the presence of mature trees (Grove et al., 2006). In comparison, younger neighborhoods typically have lower canopy cover, because of the short time since the major planting event, while older neighborhoods often have begun to experience tree mortality; large dying trees are replaced with smaller ones or not replaced at all (Grove et al., 2006; Conway and Urbani, 2007). Luck et al. (2009) and Boone et al. (2010) also found evidence of legacy effects, with historic socioeconomic conditions related to current canopy cover patterns.

Built form, including density and type of built structures, is another factor frequently correlated with urban vegetation conditions (Alberti, 2005). Detached single family houses typically have the highest percentage of tree cover, as compared to other housing types (Nowak et al., 1996), likely because such housing has relatively large properties associated with more available planting space. Road density is negatively related to urban vegetation abundance in Toronto (Conway and Hackworth, 2007), while more detailed measures of street width are negatively related to the number and size of trees in Bangalore (Nagendra and Gopal, 2010).

The relationship between neighborhood socioeconomic status and urban forest patterns has received significant attention in recent years. Neighborhoods inhabited by people with higher income and education-levels typically have higher canopy cover (Talarchek, 1990; Emmanuel, 1997; Iverson and Cook, 2000; Pedlowski et al., 2002; Luck et al., 2009; Tooke et al., 2010). Alternatively, neighborhoods with a higher percentage of renters tend to have less canopy cover (Perkins et al., 2004; Landry and Chakraborty, 2009). Several studies have found that neighborhoods with significant populations of racial minorities are also associated with lower levels of canopy cover (Heynen et al., 2006; Troy et al., 2007; Landry and Chakraborty, 2009), although the nature of this relationship is not stable across cities (Grove et al., 2006; Pham et al., 2012).

The finding that the distribution of urban canopy often varies in relation to presence of different socioeconomic groups has raised concerns around equitable access to this positive environmental feature and, therefore, the host of environmental, economic, social and health benefits imparted by trees (e.g. Emmanuel, 1997; Pedlowski et al., 2002; Heynen et al., 2006; Landry and Chakraborty, 2009). Explanations for the unevenness between socioeconomic groups have focused on wealth and access inequality contributing to different levels of opportunity and knowledge in relation to private planting and mobilization of government and non-governmental resources (Heynen et al., 2006). More recently, Pham et al. (2012) found the built environment (population density, building age) accounts for some of the uneven distribution of canopy between income groups in Montreal, suggesting physical constraints may be an underlying cause of socioeconomic-urban canopy relationships. Furthermore, Fraser and Kenney (2000) and Grove et al. (2006) showed that desire for specific land covers on residents' property varies among ethno-cultural communities and 'lifestyle groups', and is not uniform within income classes. Thus, neighborhood-level socioeconomic-canopy cover relationships are likely a result of multiple factors, including resource access, built conditions, and residents' preferences.

In terms of local actors who are actively shaping urban forest conditions, several studies have considered the role of municipal and non-governmental planting programs, as well as community group involvement in urban forestry (Conway et al., 2011). Perkins et al. (2004) examined the types of households most likely to participate in Milwaukee's municipal planting program, concluding residents who own their homes and have higher incomes were disproportionately represented. Greene et al.'s (2011) study of participation in an NGO-lead backyard tree planting program in the Greater Toronto Area produced mixed results, with characteristics of participating households varying across the region. In terms of community groups, resident associations and businesses associations often have the resources, motivation and commitment to property and community that makes them interested in the long-term benefits of planting and maintaining trees (Perkins et al., 2004). Residents association are increasingly organizing backyard tree planting programs, as well as generally raising awareness around the benefits of the urban forest (Conway et al., 2011).

In many urban landscapes, residential property represents the largest portion of the existing urban forest and the majority of potential planting sites (Troy et al., 2007), making this urban land use a key component of successful urban forest management. Collectively, residents have strong control over the urban forest's distribution and condition through the cumulative effects of their many property-level decisions. Although significant attention has been given to neighborhood-level correlations and actors, property-level research – the scale where key actors are making most of the tree planting, pruning and removal decisions for residential land – has received little attention.

While there is a lack of research explicitly examining the relationship between disaggregated household characteristics and percent canopy cover or tree density at the property-level, this fine-scale work has occurred for general landscaping preferences, ornamental gardening decisions, and lawn care activities. Household characteristics related to landscaping and ornamental gardening activities include gender and age of residents, cultural background, level of gardening experience, and socioeconomic status (Yabiku et al., 2008; Kendal et al., 2010). Loram et al. (2011) found the length of residency in one's house also influences the extent of landscaping activity residents engage in, with activity-levels reaching their peaks in mid-length residencies (15–20 years) in the UK. Education and income levels are significantly related to the property-level use of water and chemicals in lawn care (Robbins et al., 2001; Zhou et al., 2008, 2009; Larson et al., 2011), while Larson et al. (2010) found that residents' values (environmental orientations, specific yard values, etc.) are strongly related to the degree of pesticides use and general landscaping characteristics of their properties. Attitudes toward urban forests also likely influence property-level tree presence, but more research is needed on this, as well as other household-specific characteristics. The analysis described below presents an exploration of household-level characteristics related to property-level urban residential trees.