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Research paper

How green is your garden?: Urban form and socio-demographic factors influence yard vegetation, visitation, and ecosystem service benefits

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HIGHLIGHTS

- Urban form and demographic factors influence ecosystem service benefits from yards.
- Benefits also differ depending on passive or active interaction with yards.
- Yard size, age, and social advantage were positively associated with vegetation availability and use of yards.
- Greater vegetation cover in the yard was not associated with higher use.
- People with high nature-relatedness scores received both passive and active benefits.

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ABSTRACT

Private yards provide city residents with access to ecosystem services that can be realized through passive (vegetation availability) and active (time spent in yards: frequency and duration) means. However, urban densification is leading to smaller yards with less vegetation. Here, we examine how urban form and socio-demographic factors affect the potential ecosystem service benefits people can gain via passive (e.g. climate regulation) and active (e.g. recreation) pathways. Two measures of vegetation cover (0.15–2 m, >2 m) are used as a proxy for passive ecosystem service benefits, and two measures of yard use (use frequency, total time spent across a week) are used for active ecosystem service benefits. We use survey and GIS data to measure personal and physical predictors that could influence these variables for 520 residents of detached housing in Brisbane, Australia. We found house age and yard size were positively correlated with vegetation cover, and people with a greater nature relatedness and lower socio-economic disadvantage also had greater vegetation cover. Yard size was an important predictor of yard use, as was nature relatedness, householder age, and presence of children in the home. Vegetation cover showed no relationship, indicating that greater cover alone does not promote ecosystem service delivery through the active use pathway. Together our results show that people who have higher nature relatedness may receive greater benefits from their yards via both passive and active means as they have more vegetation available to them in their yards and they interact with this space more frequently and for longer time periods.

1. Introduction

With the world's urban population continuing to grow rapidly, many cities are transitioning to higher density, compact housing (Loibl & Toetzer, 2003; Radeloff, Hammer, & Stewart, 2005). Urban growth will inevitably lead to changes in urban vegetation cover and access to private green space – that is, people's private (domes-

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tic) gardens, back yards, and front yards (herein referred to as 'yards'). In areas of high residential density, yards are likely either to disappear or decline in size, while people living in the sprawling outskirts of cities may still have the opportunity to choose both the size and natural content of these spaces (Conway & Hackworth, 2007; Lowry, Baker, & Ramsey, 2012). Private yards are important because they provide city residents with immediate access to urban green space (Gaston, Warren, Thompson, & Smith, 2005; Shanahan, Lin, Gaston, Bush, & Fuller, 2014). However, they also have a significant role in contributing to overall vegetation cover in cities, as residential areas make up more than 50% of all available green space in many cities (Gaston et al., 2005; Lin, Meyers, & Barnett, 2015; Loram, Tratalos, Warren, & Gaston, 2007; Mathieu, Freeman, & Aryal, 2007; Shanahan et al., 2014).

Vegetation around the home can provide a variety of important ecosystem services that contribute to human and environmental health at local, neighborhood, and regional scales (Bolund & Hunhammar, 1999). First, urban vegetation has been shown to provide a range of services that can be delivered to people via passive pathways, in which people do not need to engage actively with the natural environment to gain benefits (Shanahan, Bush et al., 2015). For example, services such as climate regulation, shade and shelter benefits can be delivered passively even when the human recipient does not actively spend time in the yard (Bowler, Buyung-Ali, Knight, & Pullin, 2010). These benefits can reduce the energy requirements for air conditioning, peak loads of energy, and consumer costs in residential homes (McPherson, 1994). The physical presence of vegetation around the home can also provide benefits of privacy and noise reduction to buffer residential areas from urban noise pollution or unwanted views, as well as flood mitigation, where carefully designed vegetative systems reduce flood discharge by allowing greater levels of infiltration and recharge (Bolund & Hunhammar, 1999) regardless of time or desire to interact with yard vegetation. It is suspected that homes with a greater amount of vegetation surrounding them will provide a greater amount of these passive ecosystem service benefits to the residents whether or not they intentionally interact with the vegetation.

A second set of ecosystem services from yard vegetation provides a range of benefits that require active engagement for a person to gain the benefit, such as time spent in private yards leading to health and well-being benefits (Berman, Jonides, & Kaplan, 2008; Dallimer et al., 2012; Fuller, Irvine, Devine-Wright, Warren, & Gaston, 2007; Larson, Whiting, Green, & Bowker, 2014; Mitchell, 2013). In these cases, a specific human experience with the vegetation is required for the benefit to accrue, and because such experiences arise from time physically spent in green spaces, they depend on behavioural patterns of a person as well as the characteristics of the vegetation of a yard.

A range of factors influences the amount and type of vegetation in people's yards, and thus the potential ecosystem services they can gain from these spaces. For example, the presence and size of yards are inextricably linked to the history and types of urban development, which could in turn affect the availability of space for vegetation (Conway & Hackworth, 2007; Gill, Handley, Ennos, Pauleit, Theuray, & Lindley, 2008; Smith, Gaston, Warren, & Thompson, 2005). Detached housing (i.e. single-family homes) is a prevalent land use type across cities in much of the world (Davies et al., 2009; Gaston et al., 2005; Goddard, Dougill, & Benton, 2010), and compared to other urban land-use types it is generally associated with a large amount of vegetated area (Attwell, 2000; Gill et al., 2008).

However, factors beyond physical characteristics of cities also influence the abundance of vegetation around the home, leading to typically uneven coverage in Western cities (Kirkpatrick, Davison, & Daniels, 2012; Loram et al., 2007; Shanahan et al., 2014; Smith et al., 2005). Cultural background, demographics, housing type and ownership can all affect decisions to plant and maintain vegetation in private green spaces (Grove et al., 2006; Perkins, Heynen, & Wilson, 2004; Troy, Grove, O'Neil-Dunne, Pickett, & Cadenasso, 2007). For instance, people who own their own homes may be more likely to invest in tree cover to save money on heating and cooling or to enhance privacy (Bowler et al., 2010; Summit & McPherson, 1998). Suburb age also directly influences tree cover because in younger suburbs less time has elapsed for trees to be planted and become mature (Greene, Millward, & Ceh, 2011).

There is also a range of factors that can discourage new vegetation planting, or even encourage removal of old vegetation. For example, in some locations fear of increased potential for bushfires in hot and dry conditions can discourage planting around the home (Gilbert & Brack, 2007). Furthermore, the presence of urban vegetation can be associated with increased fear of crime (Gobster & Westphal, 2004; Nasar & Jones, 1997). Tree maintenance requires time, effort, and knowledge, as well as space that is a scarce commodity in densely populated areas (Kirkpatrick et al., 2012; Summit & McPherson, 1998). Vegetation around homes or near roads can also cause root damage or threaten other infrastructure with fallen limbs creating safety issues (Head & Muir, 2005; Nowak & Dwyer, 2007). Reflecting this range of motivations and barriers for planting and maintaining vegetation around the home, a growing body of research shows that socio-economic and demographic factors correlate with tree cover and species diversity within yards (Clarke, Jenerette, & Davila, 2013; Kirkpatrick, Daniels, & Zagorski, 2007; Shanahan et al., 2014; van Heezik, Freeman, Porter, & Dickinson, 2013).

Although the size of the yard and the quantity of vegetation are important determinants of the potential ecosystem services people can gain from private yards via passive means, they could conceivably influence a person's use of these spaces and thus the delivery of ecosystem services by more active pathways (such as recreational use or psychological wellbeing benefits). Certainly, there is a growing body of evidence suggesting that the vegetation in public green spaces can influence visitation of these areas (Cohen et al., 2010 Ho et al., 2005; Shanahan, Lin, Gaston, Bush, & Fuller, 2015), and experiencing a more natural setting is a common reason that people state for engaging with public green space (Chiesura, 2004; Irvine et al., 2010; Irvine, Warber, Devine-Wright, & Gaston, 2013). Furthermore, considerable evidence now shows that socio-demographic factors (including gender, age, education, income and nature orientation) influence people's use of public green spaces (Ho et al., 2005; Lin, Fuller, Bush, Gaston, & Shanahan, 2014; Zanon, Doucouliagos, Hall, & Lockstone-Binney, 2013), with nature orientation highly influencing the amount of time that people spend in green spaces (Lin et al., 2014).

However, despite the potential importance of private yards for delivering ecosystem services through active use pathways, people's use of these spaces has received relatively little attention. One would suspect, similar to public green spaces, that the vegetation content of private yards and similar socio-demographic factors would lead people to spend more time in their private yards. The studies that do exist show that families tend to spend very little time in the outside areas of their homes (Arnold & Lang, 2007; Graesch, Broege, Arnold, Owens, & Schneider, 2006); for example, in Los Angeles parents and children rarely use their yards and often primarily carry out mundane tasks when they do (taking out trash, arrivals and departures; Arnold & Lang, 2007). Thus, key questions remain regarding the extent to which physical characteristics of yards, or the personal characteristics of people, influence actual use of private yards.

Here, we examine the extent to which physical (e.g. availability of space) and personal (e.g. age, socio-economic disadvantage) factors influence the potential ecosystem services people can gain from their private yards in Brisbane, Australia – a city undergoing