**TITLE: HOMEOWNER PREFERENCES FOR WOODED FRONT YARDS AND
BACKYARDS: IMPLICATIONS FOR CARBON STORAGE**

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1. Introduction

Residential land use continues to expand beyond urban boundaries in the United States, creating a suburban landscape of single-family homes set in their own expansive yard, a privately-owned and tended property for personal use (Ekers, Hamel, & Keil, 2012; Nickerson, Ebel, Borchers, & Carriazo, 2011; Talen, 2003). These yards are dominated by mown, fertilized, and irrigated turf (e.g., Dahmus & Nelson, 2014). If the American residential landscape were less dominated by turf and more wooded, it would store more carbon to mitigate climate change (Godwin, Chen, & Singh, 2015; Vaughn, Hostetler, Escobedo, & Jones, 2014). Our study examined suburban homeowners' preferences for more or less wooded yards in order to learn how land development processes might promote more wooded suburban landscapes.

Compared with other ecosystem types, forested ecosystems store large amounts of carbon in woody biomass (Rhemtulla, Mladenoff, & Clayton, 2009). While residential areas are not forested ecosystems, our empirical study of exurban residential properties in southeast Michigan found that patches of unmown, dense woody vegetation stored almost as much carbon per area as mature hardwood forests of the region (MASKED). Mature trees or trees in dense woodlands with leaf and needle litter particularly enhance carbon storage in ecosystems (Watson et al., 2000). In Leicester, UK, 97.3% of the above ground carbon pool was found to be in trees (Davies, Edmondson, Heinemeyer, Leak, and Gaston, 2011). In suburban areas, property size and the number of trees on a property have been found to be related to carbon storage (Fissore et al., 2012). In order to consider the implications for carbon storage, we investigated homeowner preferences and behaviors that affect the presence of trees and wooded areas in suburban yards.

We surveyed homeowners in suburban residential areas including exurban development in southeast Michigan (Figure 1). Exurban development, known as peri-urban development in some parts of the world, occurs as a broad edge of very low-density development on the rural fringes of denser suburban areas. In the United States, the lower density of exurbia is typically a product of minimum lot sizes required by local governments to protect drinking water supplies from septic systems, to make agriculture viable, or to ensure rural character (Brown et al. 2008). The resulting large lots in southeast Michigan are typically larger than one acre (.405 ha) and range up to more than 20 acres (8.100 ha) and can include more extensive wooded areas (Robinson 2012).

Our general research question was whether suburban homeowners preferred their yards to be wooded and why. We hypothesized that they would prefer wooded backyards more than wooded front yards. We looked for heterogeneity among homeowners in their preferences for wooded yards, asking: do homeowners with different preferences for having wooded yards prefer different characteristics of these yards? Do they use their own yards differently? Do they manage their own yards differently? Might their preferences be influenced by the appearance of their neighbors' yards? To address these questions, we examined homeowners' preferences for yard styles that combined different types of front yards and backyards that were more or less wooded (Table 1), and we compared their stated preferences for different yard styles with the way they actually used and managed their own yards.

Yard management behaviors like tree planting and retention have been shown to be influenced by broad cultural norms, including concern over what future buyers may want, as well as more

localized neighborhood norms for particular yard styles (Blaine, Clayton, Robbins, & Grewal, 2012; Goddard, Dougill & Benton, 2013; Nassauer, Wang, & Dayrell, 2009; Schindler, 2012). Neatness is a broad cultural norm for residential landscapes because it communicates care and neighborliness (Blaine et al., 2012; Nassauer, 1993; 2011). Cues to care that indicate human presence in the landscape can include mowing, crisp, distinct edges, trimmed shrubs, and flowery plants (Nassauer, 1995; 2011). While canopy trees in a mown lawn are seen as cues to care, unmown wooded areas as well as some tree species may be perceived as “messy”, and homeowners may not want them on their own properties (Crow, Brown, & De Young, 2006; Nassauer, 1993; Kirkpatrick, Davison, & Daniels, 2012; Nassauer et al., 2014).

Compared with backyards, front yard cultural norms for mown turf may be more influential because the front publicly exhibits residents’ management choices. In the desert biome of Phoenix, Arizona, US, Larsen & Harlan (2006) found that yard styles featuring more socially correct desert plants were most preferred in the front yard, but not the backyard where residents’ choices were less affected by social norms. Another study of Phoenix found that there were significant differences in preferences for backyards and front yards, where alignment with cultural norms was particularly important (Larson, Casagrande, Harlan, & Yabiku, 2009). In temperate biomes where turf may be more preferred in the front yard, homeowners may retain or plant more trees and shrubs in backyards to achieve greater privacy (Nassauer et al., 2014; Sperling & Lortie, 2010). Such plantings screen the backyard from public view, which may allow residents to choose less tidy wooded yard styles.

Actual uses of front yards also may differ from backyards and affect the presence of trees and wooded areas. In New Urbanist-style developments in Toronto, Hess (2008) found that more respondents used their backyards than their frontyards for activities such as socializing, relaxing, and gardening despite the neighborhoods having been designed to encourage front yard use for these activities. Hess links this result to residents' desire for privacy.

Wooded neighborhoods are in part a legacy of past decisions by developers and previous homeowners (An & Brown, 2008; Boone, Cadenasso, Grove, Schwarz, & Buckley, 2010; Lowry, Baker, & Ramsey, 2012). Many studies suggest that homeowners generally appreciate having trees in a neighborhood (Vining, Daniel, & Schroeder, 1984; Sullivan, 1994; Stamps, 1997; Flowers & Gerhold, 2000; Wang, Nassauer, Marans, & Brown, 2012; Conway and Bang, 2014). Neighborhoods that are characterized by wooded areas may convey yard style norms that override broader cultural norms for turf-dominated yards (Crow et al., 2006; Goddard et al., 2013; Visscher, Nassauer, Brown, Currie, & Parker, 2014). Furthermore, residents of wooded neighborhoods may have distinct preferences for wooded yards, having "sorted" themselves in choosing neighborhoods that fulfill their preferences for trees (Hannon, 1994).

2. Methods

In the summer and fall of 2011, we conducted a web-survey of suburban homeowners. Our sample included all respondents to our 2005 homeowner web survey (MASKED), all of whom had agreed to participate in on-line surveys, and lived in the 10-county Detroit, Ann Arbor, and Flint Metropolitan Statistical Area (MSA) of southeast Michigan (Figure 1). We sampled

residents of the 207 ZIP codes in the 10-county area that include municipalities that did not provide sewer or water services and used large-lot residential zoning. In 2011, we also sampled two additional households on each street sampled in 2005, selected at random (using www.yellowpages.com/whitepages). Our survey complied with standards of our Institutional Review Board.

[Figure 1 Here]

Invitations to participate in the web survey were sent by post to 1,301 addresses in June 2011; 122 (9.4% of the initial 1,301 cards) were returned as undeliverable. In October, reminder postcards were mailed. 126 (10.7% of the remaining 1,179 deliverable mail sample) usable web surveys were returned. Our survey method, combining an initial postal contact with a requested web survey response, may have contributed to a low response rate. For this reason, it was important to compare our sample with study area population characteristics as determined by the United States Census. We used census data from county subdivisions (townships and cities) in the Detroit, Ann Arbor, Flint MSA, which had populations below 50,000 (United States Census Bureau, 2010). Compared with population data for these areas, our sample tended to be older, to underrepresent those earning less than \$49,000, and to over-represent households with children. These differences are consistent with characteristics of our target population: homeowners tend to be older, wealthier, and more likely to have children than the population as a whole (MASKED). Therefore, to address our research questions, we judged our sample to be adequately representative of our target population.

We administered our image-based web questionnaire using Qualtrics (www.qualtrics.com). Respondents saw fourteen images, one of two replicates of each of the five front yard types (Figure 2 and 3) and nine backyard types (Figure 4 and 5). They chose a most-preferred front yard and backyard as if it were to be part of their current home, disregarding cost. They then identified characteristics they preferred about their chosen front and backyard. To avoid introducing bias, the questionnaire included no text describing yards; it only showed the image. For example, it did not describe the yards as having “mature trees” or “native gardens,” and it did not describe ecosystem services or costs associated with the yard types. Respondents also answered forced-answer items about how they actually used and managed their own yards.

[Figure 2-Figure 5 Here]

The images depicting front yard types were visualizations; some were less wooded (“Conventional,” “50% Native,” and “75% Native”) and some more wooded (“Mature Tree” and “Young Tree”), and all were designed to convey “cues to care” (Figure 2 and Figure 3). The backyard images were digitally modified to show different uses of backyard space and were more or less wooded (Figure 4 and Figure 5). Large trees with little or no mown area characterized two backyard styles: “Native Woodlands with Turf Beneath” and “Native Woodlands with Little or No Turf.” The remaining backyard types were all less wooded.

Preferred characteristics: Respondents indicated what they liked about each of their most preferred yard types by selecting from a list of characteristics (Table 2). Some characteristics were

specific physical attributes of the yard, such as “the trees,” while others were more subjective, such as privacy and neatness.

Actual use of their own yard: Respondents selected activities that they did in their own front yards and backyards from a list. Then they indicated the three activities that they did most frequently.

Actual management of their own yard: We asked respondents about behaviors that could affect the presence of trees and amount of carbon stored in their yards. They indicated the percentage of their lawn that was mown; we aggregated this into a binomial variable “less than half mown” (n=36) or “half or more mown” (n=74). They reported the number of large trees (greater than 12” diameter at breast height) on their property as well as the number of trees they had planted. They also reported how they had disposed of most leaves on their property the previous fall: nothing/left in place, composted/moved, used a mulching mower, removed, or burned.

Cultural and neighborhood norms: On 5-point Likert scales, respondents indicated how much their desire to fit into the neighborhood affected their actual management of their own yard and how much having a neat yard affected their actual management choices. For analysis, we aggregated their responses to 2 or 3-point scales.

Demographic Variables: Respondents indicated their age (less than 50 years or 50 and over) and whether they had children at home, variables that we thought might affect their yard preferences.

2.1. Analysis

We analyzed the data using SPSS 20 and 21. We grouped respondents according to their preferred yard styles (combinations of preferred front yards and backyards that were “more wooded” and “less wooded”) based on a crosstabs and Chi-Square statistical analysis. This was to test whether their choice of a more wooded front yard type was independent from their choice of a more wooded backyard type. For further analysis, we then grouped respondents by the four preferred yard styles (Table 1). Using crosstabs and a Chi-Square statistic, we then compared respondents’ preferred yard styles with their preferred front yard characteristics and their preferred backyard characteristics. We also used Fisher’s Exact Test because some of our cell counts were less than five. Using McNemar’s Test, we analyzed whether front yard preferences were different from backyard preferences. We used McNemar’s Test to determine whether respondents used their front yards and backyards differently. We used crosstabs with a Chi-Square statistic and Fisher’s Exact Test to investigate whether yard management behaviors, demographic variables, or the effects of cultural and neighborhood norms varied with homeowner’s yard style preferences.

3. Results

3.1. Stated preferences for more or less wooded yards: Preferred yard style

By far the most respondents preferred a front yard with mature trees (61.3 %) (Figure 2), followed by the most conventional turf-dominated front yard (20.2%) (Figure 3). Fewer respondents preferred front yards that were dominated by tree plantings or prairie gardens. For their backyard, a turf-dominated flower garden with some trees was preferred by the most

respondents (31.2%)(Figure 4).At the same time, together, the two backyard types that featured dense woodlands were preferred by 36.0% (Figure 5).Results did not support our hypothesis that homeowners would be more likely to prefer a more wooded backyard than to prefer a more wooded front yard. In fact, respondents were significantly more likely to prefer a wooded front yard (McNemar $p<0.05$).Note that wooded backyards shown in the survey featured dense woodlands, butthe mature wooded front yard preferred by survey respondentsdid not.

Preferences for front yard typeswere not independent from preferences forbackyard types (Chisquare=6.035, $p<0.05$).Having learned this, we grouped respondents by their four preferred yard styles, combinations of related front yard and backyard preferences (Table 1): *Overall Woodland Style* (OWS), *Backyard Woodland Style* (BWS), *Turf and Tree Style* (TTS), and *Turf Style* (TS).

More than half of all respondents preferred front yards and backyards that were similar in how much they were wooded; 27.4%preferred a more wooded front yard and backyard (OWS) and 29.0% preferred a less wooded front yard and backyard (TS).Amongthose who preferred a more wooded backyard,77% also preferred a more wooded front yard (OWS).Among those who preferred a less wooded backyard,45% preferred a less wooded front yard (TS), and 55% preferred a more wooded front yard (TTS). Only 8.1% of respondents preferred a less wooded front yard and a more wooded backyard (BWS).Overall, 71.0% of respondents preferred a wooded front or backyard.

[Table 1 Here]

3.2.Heterogeneity across different yard styles: Preferred characteristics of the yard

Respondents who had different yard style preferences also tended to prefer different characteristics about the yards that they most preferred (Table 2).

Trees: Respondents who preferred different yard styles were significantly different in identifying “the large trees” and “the number of trees” as reasons for their front yard preferences (Large Trees: Fisher’s Exact Test=61.831; $p<0.05$, $n=124$, Tree Number: Fisher’s Exact Test: 30.197, $p<0.05$, $n=124$). Respondents who preferred different yard styles also were significantly different in identifying “it’s shady” as a reason for their backyard preference (Fisher’s Exact Test: 10.739, $P<0.05$, $n=124$). OWS and TTS respondents were most likely to indicate that they preferred trees in the front yard. TS respondents were least likely to state they preferred a backyard because it was shady (Table 2).

Neatness: While neatness was highly preferred for all yard styles (> 50% except for the backyards of OWS), there were significant differences in identifying neatness as a preferred front yard characteristic (Fisher’s Exact Test: 9.320, $p<0.05$, $n=124$) and as a preferred backyard characteristic (Fisher’s Exact Test: 13.272, $p<0.05$, $n=124$). Among those who chose a less wooded front yard, neatness was more frequently preferred in the front yard: 90.0% of BWS respondents and 86.1% of TS respondents (Table 2). Those who preferred the BWS more frequently wanted neatness in the backyard.

[Table 2 Here]

229

230 *Fitting in with the Neighborhood:* “Fitting in” with their current neighborhood was not
 231 significantly different among homeowners who preferred different yard styles (Front yard:
 232 Fisher’s Exact Test=1.587, $p>0.05$, $n=124$; Backyard: Fisher’s Exact Test=0.396, $p>0.05$,
 233 $n=124$). While “fitting in” consistently affected yard preference, it was less important than other
 234 characteristics.

235

236 *Privacy:* Privacy preferences were significantly different across the four yard styles, in the front
 237 yard (Fisher’s Exact Test: 19.569, $p<0.05$, $n=124$) and the backyard (Fisher’s Exact Test: 11.554,
 238 $p<0.05$, $n=124$). Privacy was important to OWS respondents for both the front (55.9%) and
 239 backyard (82.4%). While only 22.2% of TS respondents preferred privacy in the front yard, 44.4%
 240 wanted privacy in the backyard. None of the BWS respondents preferred privacy in the front
 241 yard, but 70% liked it in the backyard.

242

243 *Wildlife:* Respondents with different yard style preferences were significantly different in
 244 wanting a front yard (Fisher’s Exact Test: 11.872, $p<0.05$, $n=124$) or backyard (Fisher’s Exact
 245 Test: 10.958, $p<0.05$, $n=124$) that looked attractive to wildlife. While only 50.0% of TS
 246 respondents wanted a backyard that looked attractive to wildlife, about 80% of those who
 247 preferred other yard styles did. A front yard that looked good for wildlife was less popular, but
 248 those who preferred wooded front yards more frequently wanted their front yard to look good for
 249 wildlife.

250

Environment: Respondents who preferred different yard styles were significantly different in choosing a yard because “it looks good for the environment” in the front yard (Fisher’s Exact Test: 12.098, $p < 0.05$, $n = 124$) and the backyard (Fisher’s Exact Test: 13.325, $p < 0.05$, $n = 124$). Those who chose a more wooded front yard (OWS and TTS) more often identified this as important in both the front and backyard, while TS respondents chose it least frequently overall.

Flowers: Preferences for “the flowers” in the front yard was not significantly different across the yard styles (Fisher’s Exact Test: 7.047, $p > 0.05$, $n = 124$), but was significantly different in the backyard (Fisher’s Exact Test: 13.720, $p < 0.05$, $n = 124$). Over half of those who had chosen a less wooded backyard (TTS and TS) indicated that they preferred flowers there.

Gardening: Respondents who preferred different yard styles had different preferences for gardening in backyards (Fisher’s Exact Test: 11.035, $p < 0.05$, $n = 124$), with TTS and TS more often selecting it as important.

Respondents with different yard style preferences were not significantly different ($p < 0.05$) in their preferences for these front yard characteristics: flowers, proportion of yard mown, meeting the household’s needs, fitting into the neighborhood, and being affordable and practical to maintain, or these backyard characteristics: proportion of yard mown, space for pets, being a good place for children to play, sunniness, fitting into the neighborhood, and being affordable and practical to maintain.

3.3. Differences between front yard and backyard preferences

Considering all respondents together, preferences for several yard characteristics were significantly different between the front yard and the backyard (McNemar $p < 0.05$) (Table 3): tree predominance (Chi-Square 17.413, $n=125$), neatness (Chi-Square: 14.922, $n=125$), privacy (Chi-Square: 6.759, $n=125$), wildlife (Chi-square: 11.885, $n=125$).

[Table 3 Here]

Tree Predominance: 61.3% of respondents indicated that “the large trees” were preferred in their most preferred front yard, compared with only 46.0% preferring shade in their most preferred backyard (Table 2).

Neatness: Neatness was widely preferred in both front and backyards, but significantly more often in the front yard. For example, those who preferred OWS yards much more frequently preferred neatness in the front yard (64.7%) than in the back (29.4%). This was also true for those who preferred a turf-dominated yard: TS (Front yard: 86.1%, Backyard: 54.0%).

Privacy: Privacy was more frequently preferred in the backyard and most often by those who preferred more wooded backyards (OWS: 82.4%, BWS: 70%).

Wildlife: The appearance of being “good for wildlife” was more frequently preferred in the backyard. It was least important to those who had a very neat yard style preference: TS.

We found no significant difference ($p < 0.05$) between front yard and backyard preferences in: looking good for the environment, flowers, fitting with the homeowner's current neighborhood, being affordable and practical to maintain, and proportion of yard mown.

3.4. Use of their own yards

Reporting on their regular yard use, respondents had used their own backyards more often than front yards for all activities (Table 4). The front yard was very seldom used for exercising, relaxing, parties, children's play, storage, or pet exercise. It was most frequently used for gardening and viewing from inside the home.

[Table 4 Here]

3.5. Actual management that affects carbon storage in their own yards

Respondents reported on several management behaviors that would affect carbon storage in their own yards (Table 5). However, only one of these behaviors varied significantly among those who preferred different yard styles: the proportion of their property that was mown lawn (Fisher's Exact Test = 12.655, $p < 0.05$, $n = 109$). Consistent with their yard style, those who preferred a more wooded front yard (OWS and TTS) were more likely to mow less than half of their actual yard (Table 5).

[Table 5 Here]

3.6. Management of their own yards: cultural and neighborhood norms

Regardless of their yard style preferences, about three quarters of respondents indicated that fitting into the neighborhood affected their own yard management decisions; there was no significant difference. Similarly, the cultural norm of neatness affected all respondents' management of their yards, and there was no significant difference among yard styles (Table 6).

Interestingly, respondents also frequently reported that their management choices were affected by their desire to care for the environment – not as much as neatness, but nearly half of each style group reported that caring for the environment very much affected how they managed their own yard (Table 6).

[Table 6 Here]

There was a notable difference between the proportion of respondents who reported that fitting in with the neighborhood was important to their choice of most preferred yards (30-50% across the yard styles) (Table 2) and the 73-81% who reported that fitting in with the neighborhood actually did affect the way they managed their own yard (Table 6). To measure this difference, we compared the effect of “fitting in with the neighborhood” on respondents' actual management of their own yards with the stated effect of “fitting in with the neighborhood” on their choice of preferred front yard or backyard. There was no significant relationship between “fitting in” affecting actual yard management and “fitting in” affecting stated preference (Table 7).

[Table 7 Here]

3.7. Demographic variables

Respondents with different yard style preferences were not significantly different in age or having children in the household (Table 8).

[Table 8 Here]

4. Discussion:

Our results have implications for design and planning tactics that could enhance carbon storage in the suburban residential landscape by increasing trees and woodlands, which we describe in this section. Our results are consistent with conclusions from past research, but their interpretation must be limited by the low return rate of our survey. However, we are sufficiently confident about the representativeness of our sample to interpret our results below, and suggest directions for future research.

Our study suggests that suburban homeowners are heterogeneous in their preferences for wooded yards. This finding is consistent with investigations of urban tree preferences elsewhere (Boone et al., 2010; Jones, Davis, & Bradford, 2013; Pearce, Davison, & Kirkpatrick, 2015). Recognizing heterogeneity may be important to building understanding of suburban landscape patterns, including the location and extent of wooded areas for carbon storage (Polsky et al., 2014). For example, describing heterogeneity among different types of homeowners is fundamental to

365 building agent-based models of suburban landscape development processes (e.g., Brown &
366 Robinson, 2006).

367 Recognizing heterogeneity also may support targeting particular audiences with tactics to
368 enhance specific ecosystem services (Polsky, 2014). For example, in our study, respondents who
369 preferred the entire yard to be more wooded stand out as having distinct preferred yard
370 characteristics: they liked large trees and privacy, wanted a yard that was good for wildlife and
371 good for the environment, did not prefer having flowers in the front yard or a garden in the
372 backyard, and were less concerned about neatness in the backyard. Tactics to store more carbon
373 in their yards might promote the habitat value of more extensive areas of dense trees with a
374 shrubby understory in the yard. In contrast, respondents who preferred a more turf-dominated,
375 less wooded yard liked flowers and neatness in the entire yard, did not want shade in the
376 backyard, and were less concerned about having a yard that was good for wildlife or good for the
377 environment. Tactics to store more carbon in their yards might include mature canopy trees that
378 are not too dense to screen the view beyond, and a low even ground plane including garden
379 plantings, as shown in our survey. Older trees store more carbon than young trees, and design and
380 planning should protect older trees in the development process as well as from unwise
381 homeowner decisions (Schmitt-Harsh, Mincey, Patterson, Fischer, & Evans, 2013).

382

383 Certain preferences may be common even among homeowners who prefer different yard styles. In
384 our survey, most respondents preferred wooded front yards, which exhibited several cues to care,
385 including a low herbaceous understory that allowed a clear view to the front of the house, crisp
386 edges around planting beds, and prominent mowing. These cues most likely enhanced

homeowners' preferences for wooded front yards(Nassauer 1988, 1997).Neatness was strongly preferred in all types of front yards, and respondents indicated that their front yards were used most frequently for gardening and viewing from inside their home.While most respondents preferred having large trees in the front yard, less than half preferred shade in the backyard, and only about a third preferred a backyard featuring dense woodlands.This suggests that backyards that include dense woodlands, which store more carbon per meter than other suburban land covers, could be designed to have broader appeal, as did the front yard designs that employed more cues to care.Future studies that incorporate more different designs for backyards with dense woodlandsand a wider range of cues to carecould be helpful.

Differences between the front and backyard have implications for carbon storage. Front yards are used less frequently and for fewer activities, but designs to enhance carbon storage in the backyard must accommodate a greater number and range of activities. Homeowners widely prefer a private backyard that is "good for wildlife" and can be used for socializing and play. Planting and retention of trees and shrubs could help to achieve these characteristics. At the same time, some homeowners' desire for flower or food gardens may limit their acceptance of trees that shade the yard.For these homeowners, designs that incorporate more trees should allow for some of the backyard to get adequate sunlight for gardening.

Design and planning tactics to enhance carbon storage in suburban yards must take into account neighborhood norms and legacy effects of past developer and homeowner choices.Neighborhood associations can also dictate what homeowners may do in their yards. However, in our previous study, we did not find a significant relationship between being in a neighborhood association and lawn mowing (MASKED). Regardless of whether they identified fitting in with the neighborhood as affecting their yard preferences, a desire to fit into the neighborhood was very

important to our respondents' actual management of their own yard. While neatness was very important to our respondents who preferred a turf-dominated front yard, some homeowners may have a neat front yard because they want to fit in with neighborhood norms. In addition, our results suggest that the legacy of past development decisions may affect whether trees are planted in suburbia. For example, while respondents who preferred wooded front yards actually did mow a smaller proportion ($< 50\%$) of their own yards, they did not have or plant more trees than those who had other yard style preferences. Previous studies have found that tree planting behavior may be related to the legacy effect of developers' decisions about lot size: larger lots are related to more tree planting (Fissore et al., 2012, MASKED). Legacy effects and related neighborhood norms together may create a drag on landscape change, particularly where many small landholders may interpret the appearance of their neighbors' yards as indicating what is appropriate for their own property (MASKED).

5. Conclusions

Retaining existing trees and planting more trees to increase carbon storage as part of residential landscapes can be achieved with greater knowledge of homeowner's preferences and behaviors. Suburban homeowners have heterogeneous preferences for yard styles that are more or less wooded, and they have varying preferences for certain characteristics of their yards, including privacy, being good for wildlife, and having flowers and gardens. These differences should point designers and planners to develop a menu of tactics that match distinct sets of preferences in order to increase the trees and woodlands in residential landscapes. The way

432 homeowners with heterogeneous preferences have sorted themselves in their home choices could
433 affect what tactics work.

434

435 While previous studies have consistently found that people value trees in their neighborhood,
436 especially in neighborhood open spaces, our study suggests that, to varying degrees,
437 homeowners also value trees on their own properties if the wooded areas look sufficiently neat
438 and fit into the appearance of the neighborhood. Yards with more trees to store carbon may be
439 more widely adopted in neighborhoods or subdivisions that have more trees, creating a “virtuous
440 cycle” of carbon storage. This suggests that local governments should engage early in the
441 development process to promote subdivision patterns to include more extensive wooded areas. If
442 design and policy align with homeowner preferences, yard activities, and cultural norms to
443 achieve enhanced carbon storage, landscape designs that include more wooded areas will be
444 more likely to last and provide ecological benefits into the future.

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Tables

Table 1: Yard styles: More wooded and less wooded yard styles were combinations of different front yard and backyard types. Chi Square: 6.035, $p < 0.05$

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Table 1: Yard styles: More wooded and less wooded yard styles were combinations of different front yard and backyard types. Chi Square: 6.035, $p < 0.05$

		More Wooded Front Yard (n=78)	Less Wooded Front Yard (n=46)
More Wooded Backyard (n=44)	Front Yards	Overall Woodland Style (OWS) n = 34 (27.4% of Total)	Backyard Woodland Style (BWS) n = 10 (8.1% of Total)
	Backyards
Less Wooded Backyard (n=80)	Front Yards	Turf and Tree Style (TTS) n = 44 (35.5% of Total)	Turf Style (TS) n = 36 (29.0% of Total)
	Backyards

Table 2: Preferred characteristics across the four yard styles: the percentage of respondents in each style who preferred each characteristic

	Yard Styles				Total	Chi-Square	Fishers
	Overall Woodland Style (OWS) n=34	Backyard Woodland Style (BWS) n=10	Turf and Tree Style (TTS) n=44	Turf Style (TS) n=36	124		
% of total respondents within each style	27.4%	8.1%	35.5%	29.0%	100%		
	Number of responses (Percent of respondents within each style)				% of total respondents	(* =sig. at 0.05 level)	(* =sig. at 0.05 level)
TREES were a preferred characteristic...							
In the front yard: The large trees	31 (91.2%)	2 (20.0%)	37 (84.1%)	6 (16.7%)	76 (61.3%)	59.842*	61.831*
In the front yard: The number of trees	31 (91.2%)	4 (40.0%)	40 (90.9%)	17 (47.2%)	92 (74.2%)	31.327*	30.197*
In the backyard: It's shady	21 (61.8%)	4 (40.0%)	23 (52.3%)	9 (25.0%)	57 (46.0%)	10.636*	10.739*
NEATNESS was a preferred characteristic...							
In the front yard	22 (64.7%)	9 (90.0%)	26 (59.1%)	31 (86.1%)	88 (71.0%)	9.424*	9.320*
In the backyard	10 (29.4%)	8 (80.0%)	25 (56.8%)	24 (66.7%)	67 (54.0%)	13.464*	13.272*
Would FIT in my NEIGHBORHOOD was a preferred characteristic...							
In the front yard	14 (41.2%)	5 (50.0%)	14 (31.8%)	14 (38.9%)	47 (37.9%)	1.484	1.587
In the backyard	13 (38.2%)	4 (40.0%)	19 (43.2%)	16 (44.4%)	52 (41.9%)	0.328	0.396
PRIVACY was a preferred characteristic							
In the front yard	19 (55.9%)	0 (0.0%)	24 (54.5%)	8 (22.2%)	51 (41.1%)	18.628*	19.569*
In the backyard	28 (82.4%)	7 (70.0%)	25 (56.8%)	16 (44.4%)	76 (61.3%)	11.354*	11.554*
Good for WILDLIFE was a preferred characteristic...							
In the front yard	21 (61.8%)	4 (40.0%)	29 (65.9%)	11 (30.6%)	65 (52.4%)	11.919*	11.872*
In the backyard	27 (79.4%)	8 (80.0%)	36 (81.8%)	18 (50.0%)	89 (71.8%)	11.929*	10.958*
Good for the ENVIRONMENT was a preferred characteristic...							
In the front yard	20 (58.8%)	3 (30.0%)	30 (68.2%)	12 (33.3%)	65 (52.4%)	12.215*	12.098*
In the backyard	19 (55.9%)	7 (70.0%)	29 (65.9%)	10 (27.8%)	65 (52.4%)	13.377*	13.325*
FLOWERS were a preferred characteristic							
In the front yard	11 (32.4%)	7 (70.0%)	19 (43.2%)	21 (58.3%)	58 (46.8%)	7.167	7.047
In the backyard	7 (20.6%)	3 (30.0%)	26 (59.1%)	19 (52.8%)	55 (44.4%)	13.522*	13.720*
Good place to GARDEN was a preferred characteristic (not asked for front yard)							
In the backyard	11 (32.4%)	6 (60.0%)	29 (65.9%)	24 (66.7%)	70 (56.5%)	11.212*	11.035*

Table 3: Preferred yard characteristics with significant differences between front yard and backyard.

Characteristic	P-value, Chi-square	n	McNemar
Tree Predominance**	p<0.05, 17.413	125	p<0.05
Neatness	p<0.05, 14.922	125	p<0.05
Privacy	p<0.05, 6.759	125	p<0.05
Wildlife	p<0.05, 11.885	125	p<0.05
** “the large trees” in the front yard and shadiness in the backyard)			

Table 4: Frequency of activities reported in their own front yard and backyard

Activity	Overall frequency in Front yard	Overall frequency in Backyard	Three most frequent uses of Front Yard	Three most frequent uses of Backyard
	Number of responses (Percent of total)		Number of responses (Percent of total)	
Viewing wildlife/feeding birds	51 (40.5%)	102 (81.0%)*	43 (34.1%)	59 (46.8%)*
Sports/exercise/walking	10 (7.9%)	42 (33.3%)*	3 (2.4%)	8 (6.3%)
Relaxing/lounging/eating	38 (30.2%)	105 (83.3%)*	20 (15.9%)	75 (59.5%)*
Car or other motor vehicle or boat storage or maintenance	20 (15.9%)	26 (20.6%)	13 (10.3%)	5 (4.0%)
Parties/events, etc	8 (6.3%)	77 (61.1%)*	3 (2.4%)	24 (19.0%)*
Childrens' play space	29 (23.0%)	52 (41.3%)*	21 (16.7%)	22 (17.5%)
Other storage	1 (0.8%)	28 (22.2%)*	1 (0.8%)	6 (4.8%)
Viewing it from inside your home	93 (73.8%)	100 (79.4%)	65 (51.6%)	40 (31.7%)*
Gardening	75 (59.5%)*	101 (80.2%)*	62 (49.2%)	63 (50.0%)
Pet exercise space	33 (26.2%)	67 (53.2%)*	20 (15.9%)	43 (34.1%)*
Other	3 (2.4%)	9 (7.1%)	-	3 (2.4%)
I do not use my front/back yard	12 (9.5%)	1 (0.8%)*	-	-

*McNemar Test Significant at p<0.05

Table 5: Yard style preference by respondents' carbon storage behaviors in their own yards

[illegible]

Table 7: Effect of neighborhood norms: Yard preferences versus actual management of their own yard

		Neighborhood Fit as a Stated Preferred Front Yard Characteristic Number of responses (% of Column total)			Neighborhood Fit as a Stated Preferred Backyard Characteristic Number of responses (% of Column total)		
		No	Yes	Chi-Square	No	Yes	Chi-Square
Influence of Neighborhood Fit on Actual Yard Management	Affects very little	15 (23.1)	10 (21.7)	2.392	13 (20.6)	12 (25.0)	0.329
	Somewhat affects	22 (33.8)	10 (21.7)		19 (30.2)	13 (27.1)	
	Affects very much	28 (43.1)	26 (56.5)		31 (49.2)	23 (47.9)	
TOTAL:		65 (100)	46 (100)		63 (100)	48 (100)	

Table 8: More wooded/less wooded preference typology by demographic variables

	Overall Woodland Style (n=34, 27.4% of total)	Backyard Woodland Style (n=10, 8.1% of total)	Turf and Tree Style (n=44, 35.5% of total)	Turf Style (n=36, 29.0% of total)	TOTAL (% of total respondents)	Chi-Square (* =sig. at 0.05 level)	Fishers
Demographic Variables	Number of responses (Percent of total within each style)						
Age							
Less than 50	15 (44.1%)	6 (60.0%)	17 (38.6%)	12 (33.3%)	50 (40.3%)	2.595	2.589
50 or over	19 (55.9%)	4 (40.0%)	27 (61.4%)	24 (66.7%)	74 (59.7%)		
CHILDREN							
NO	22 (64.7%)	5 (50.0%)	26 (59.1%)	23 (63.9%)	76 (61.3%)	0.897	0.979
YES	12 (35.3%)	5 (50.0%)	18 (40.9%)	13 (36.1%)	48 (38.7%)		
*some columns do not add up to the totals because not all respondents answered all questions							

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Figure1

Figure 1: Southeast Michigan Study Region

Figure 2: More wooded front yard types and the number of respondents who preferred them most

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