ABSTRACT

DETERMINANTS OF WILLINGNESS TO PLANT POLLINATOR BENEFICIAL PLANTS ACROSS A SUBURBAN TO RURAL GRADIENT

by Jessica Stoyko

Pollinators provide humans with a varied diet, yet their numbers are in decline, partially due to habitat loss. Yards can provide suitable floral and nesting resources for pollinators, but residents may be hesitant to make such changes to their yards depending on their lifestyle, socio-economic characteristics, and social norms surrounding yard care. Two hundred surveys were deployed in Darke County and Miami County, Ohio asking residents about their yard management practices and values in addition to their willingness to plant three pollinator beneficial plants: *Asclepias syriaca*, *Echinacea purpurea*, and wildflowers (multiple *spp.*). One hundred and thirteen surveys were returned and analyzed through random forest models and linear regressions. We found that residents are less willing to plant these pollinator beneficial plants if they like to keep their backyards neat and tidy, but *more* willing to plant these if they report enjoying outdoor activities. Residents with higher incomes were more willing to plant wildflowers and *A. syriaca*. Together, these results indicate that this coupled human-natural system is strongly influenced by residents' lifestyle in the form of aesthetics, outdoor recreation, and expendable income.

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Table of Contents

List of Figures

Appendices

List of Tables

Appendix

Dedication

Without the support of my family, I would have never made it this far. I dedicate all the drive that went into this thesis to my children. James and Jonah. I hope I have taught you to forge ahead with your dreams despite hardships, negativity, and adversity. I love you both, and I will never turn you away if you need encouragement. Thank you for your patience while I gained an education, and thank you for inspiring me to be a better person. To Warren, my partner of nearly eleven years, who has continued to support us through all our trials and made it his goal to help me see my underutilized intelligence. Were it not for him, I would have never considered attending Miami University's Regional Campus. Thank you, and I love you. Janeanne and David, without you two, I would have never known how families should treat each other during good times and bad. To the few friends that stuck around when things were tough, thank you for weathering the storms with me. For those that helped out when they could, thank you for the contributions. Finally, I'd like to thank Geography Department faculty and staff who helped us meet our educational goals despite the COVID-19 pandemic.

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Introduction

Pollinators are declining yet, without bees, the most effective pollinators for myriad crops humans like to consume, our diets would be substantially poorer (Betts et al., 2019; Levé et al., 2019; Mach & Potter, 2018). Land cover changes leading to a loss of habitat, is one of multiple drivers of bee decline. Securing nesting and floral resources will be a gateway to long-term pollinator survival, and it is important to find spaces to do so. Citizen perception of public green spaces where pollinator beneficial practices and flowers are instituted include considerations of aesthetics, environmental friendliness, and safety (Ramer et al., 2019; Turo & Gardiner, 2019). Public green spaces are not the only avenues researchers utilize to gauge citizen perceptions of pollinator beneficial plants. The potential for creating (or maintaining) pollinator habitat on private lands is large (Derby-Lewis et al., 2019; Thogmartin et al., 2017). Quantifying the potential for pollinator conservation on private land requires an understanding of attitudes about pollinators and pollinator beneficial plants (Larson et al., 2020, Ramer et al., 2019), quantifying pollinator abundance and species richness on private properties (Cutting & Tallamy, 2015; Lerman & Milam; 2016; Levé et al.;2018, Mach & Potter, 2018; Otto et al., 2020), and elucidating a range of social characteristics and behaviors.

Public Perception of Pollinator-Beneficial Plants

Ramer et al. (2019) wanted to gauge park visitors' attitudes about flowering bee lawns in public parks, and whether or not perceptions related to lawn aesthetics, bees, and frequency of park visits was related to the visitors' sociodemographic characteristics. Surveys were conducted before and after an informational session about the benefits of flowering lawns for bees (Ramer et al., 2019). Those who were in strong support of flowering lawns prior to the informational session were still in strong support of flowering lawns as a place to provide sustenance for bees afterward. However, those in moderate support for flowering lawns prior to the informational session expressed less support for flowering lawns once they found out it provides sustenance for bees (Ramer et al., 2019). Additionally, the support for flowering bee lawns increased with age (Ramer et al., 2019). Aesthetics related to flowering lawns were a major benefit for park visitors who felt that an aesthetically pleasing flowering lawn showed a sense of communal belonging, pride, and responsibility for their surroundings. Respondents did express concerns over the presence of flowering lawns including whether or not gardens would be maintained on a regular basis. In particular, some visitors to the park who may not know much about flowering plants might think they are just weeds during non-flowering times (Ramer et al., 2019). Overall, while a third of the respondents seemed to tolerate bees (and only half of the respondents stated they liked bees), respondents mostly seemed to care about the aesthetic of a flowering bee lawn (Ramer et al., 2019) which shows the importance of finding plants that will be palatable to both pollinators and humans.

In the vein of public green spaces which benefit pollinators, Turo & Gardiner (2019) speculate on how public green spaces should be designed to please both pollinator species and residents of the city. After assessing both ecological requirements for pollinator habitat conservation and social perceptions of pollinator habitat, Turo and Gardiner (2019) suggest a few steps to secure pollinator conservation in public spaces long-term. They also emphasize that communities should be involved in the decision-making process, as citizens' aesthetic values and safety concerns about pollinator conservation may be difficult to market in urban areas (Turo & Gardiner, 2019). Two concerns citizens may have, include: (1) will the spaces be aesthetically pleasing and (2) will tall grasses in neighborhoods with higher crime rates be a place for criminals to hide themselves or illegal objects (Turo & Gardiner, 2019). Green public spaces that are beneficial for pollinators are in need of a compromise between community members' concerns, and ecologically sound habitat for pollinators.

We now know that public citizens have strong opinions about pollinator gardens and bees in public places, but how do private citizens' views on pollinators in their own yards differ from the public sphere? Larson et al. (2020) gave us a glimpse into Phoenix, Arizona residents' attitudes about bees, and compared them with multiple social factors including but not limited to: age, household income on an 11-point scale, whether or not residents had cats and/or dogs, distance from residents' home to the nearest desert parks, and attitudes about the environment. Out of all residents, 19% stated they like bees a lot and 19% like bees somewhat (Larson et al., 2020). Conversely, 26% dislike bees a lot and 17% dislike bees somewhat (Larson et al., 2020). Nineteen percent of the respondents chose neither like bees nor dislike bees (Larson et al., 2020). Average age of residents (M = 51), 5.63 km to the nearest desert parks, ownership of cats, ownership of dogs, and pro-environmental attitudes were positively linked to attitudes about bees (Larson et al., 2020). Residents' household income between $80,000 and $100,000 was negatively associated with attitudes about bees (Larson et al., 2020)

Role of Private Urban Gardens for Pollinators

Urban gardens have the potential to provide sustenance for pollinator species given the high plant diversity found in urban yards as well as the large cumulative spatial extent of urban yards (Betts et al., 2019; Davis et al., 2021; Derby-Lewis et al., 2019; Levé et al., 2018; Mach and Potter, 2018; Ramer et al., 2019; Van Heezik et al., 2020).

Van Heezik et al. (2020) recruited 42 residents in New Zealand to ask them about their preferred environmental activities to gauge interest in native wildlife activities. If respondents were engaged in environmental activities, and gave consent to join the study, they were asked to state their first and second choices of six activity options. Said “garden activities” were: building a bird feeder, lizard refuge and plant, planter for bees, tunnel and ink card for tracking hedgehog prints, two native shrubs, and a log pile for invertebrates (Van Heezik et al. 2020). Relevant to this study, are the planter for bees, and native shrubs. Twenty-five respondents chose the bee planter, and 11 chose to plant native shrubs. The most popular two-choice combination in Van Heezik et al.’s (2020) study was the bird feeder and bee planter with 16. Among this group of people, over half of them wanted to increase bee visitations, but only about a quarter agreed to the planting of native shrubs (Van Heezik et al., 2020).

Derby-Lewis et al. (2019) found that despite being major metropolitan areas, Minneapolis-Saint Paul, MN, Chicago, IL Kansas City, MO and Austin, TX still have a considerable amount of green space that could be used to provide resources for pollinators; they focus specifically on Monarch Butterflies (*Danaus plexippus*). They find that of the different land use types they examine, residential gardens have the highest potential for planting milkweed (the host plant for Monarch Butterflies; Derby-Lewis et al. 2019).

Levé et al. (2018) used citizen science data in France to assess pollinator species richness in urban gardens at multiple spatial scales. Impervious surfaces that surrounded domestic gardens seemed to determine an increase in pollinator species richness at a fine spatial scale of 50 m and 100 m compared to the reverse pattern of domestic gardens that surrounded impervious surfaces (Levé et al., 2018). Broad spatial scales did not exhibit this pattern, as the local effect (defined by pollinator species richness within domestic gardens), was the single variable that exhibited the highest overall species richness regardless of landscape variation (Levé et al., 2018). Their research underscores the importance of having aggregations of urban gardens with pollinator beneficial plants within otherwise inhospitable matrices.

Of course, not all greenscape or green infrastructure is created equally in the eyes of pollinators, and plant species found in yards matter to pollinator species richness, and communities. In the Ohio River Valley (Southern Ohio and Kentucky), Mach and Potter (2018) quantified 72 assemblages of flowering, woody, pollinator-beneficial plant species, and their attractiveness to pollinators. They found that the average count for bees among all plants within a 30 second snapshot was 12.8. The five most popular plants for bee attractiveness were Shining Sumac (*Rhus copallinum*), Bee-bee tree or Korean Evodia (*Tetradium daniellii*), Amur Maackia (*Maackia amurensis*), Seven Sons Tree (*Heptacodium miconioides*), and Panicled Hydrangea (*Hydrangea paniculata*). None of the aforementioned plant species are native to the United States and all of these were intentionally planted by home gardeners.

Urbanization's Varied Effects on Biodiversity

Miller and Hobbs (2002) brought to light the fact that within five volumes of the journal Conservation Biology, topics regarding conservation within human-inhabited lands are meager at best. They argued that if we do not know how humans are modifying the land they inhabit, conservationists cannot focus their efforts where they are needed the most (Miller & Hobbs 2002). Out of 217 papers related to human settlement, less than 6% were performed in "urban, suburban, or exurban areas" (Miller & Hobbs, 2002). The authors say this is due to the traditional conservation science view that humans are somehow separate from the environment (Miller & Hobbs, 2002). Therefore, the value systems of many conservation biologists and ecologists are based on learning the functionality of undisturbed ecosystems with the ultimate goal of ecological preservation as something to be achieved separately from human influence (Miller & Hobbs, 2002). Miller and Hobbs (2002) call for Conservation Biologists to begin looking outside their traditional disciplinary boundaries, while Standish et al. (2013) argue the need to work with multiple land stakeholders, so that we may elucidate effects of neighborhood and individual yards' spatial and land cover composition on urban wildlife, as well as identify ecologically friendly strategies that mitigate negative impacts of human settlement on wildlife.

Urbanization however does not necessarily lead to a decrease in species richness for many taxa. McKinney (2008) conducted an extensive literature review of 105 studies highlighting the effects of urbanization on the species richness of non-avian species (as a plethora of studies about the effects of urbanization have involved bird taxa). Urbanization was classified into three intensity levels: low, moderate (mid-level), and high (McKinney, 2008). Out of 105 studies, 17 were about plants, five about insects, 13 about butterflies, three about moths, six about bees, ten about beetles, three about flies, and one about bats to name a few categories of pollinators (McKinney, 2008). In the grand majority of cases, high levels of urbanization, defined as “core urban areas,” experienced major decreases in species richness (McKinney, 2008). However, moderate urbanization such as housing density commonly observed in the suburbs had mixed effects (McKinney, 2008). At the time of this 2008 review, for over half of the plant studies, moderate urbanization resulted in higher species richness, and for the invertebrates (which include insect pollinators), this resulted in a 30% increase in species richness (McKinney, 2008). The author concludes that domestic gardens, situated in low to mid-level housing density, need to be further examined focusing especially on yard management decisions, native vs. nonnative plant species decisions, and ultimately whether or not pollinators are attracted to said plant species and can thrive in such environments (McKinney, 2008).

Standish et al. (2013) proposed four strategies for ecological restoration in urban settings, and discussed pros and cons of each. The two strategies that deal with individual residents' landscape management decisions are called, “novel ecosystems” and “gardening with iconic species” (Standish et al., 2013). Novel ecosystems are those that include both native and nonnative plants due to the residents’ gardening choices (Standish et al., 2013). Standish et al. (2013) argue that gardening in and of itself can strengthen the connection people have with nature. Indeed, not all nonnative plant species are harmful to the environment, and some can in fact, provide suitable nectar or pollen for various pollinators so those yards become vessels for pollinator conservation or restoration (Standish et al., 2013). The second relevant mitigation strategy, gardening with iconic species, is important from a conservation standpoint because it gives humans direct contact with nature (Standish et al., 2013). This concept relies heavily on personal choice and values. For example, residents may decide to plant “iconic native plant species” in order to feel a “sense of place”, and cities with multicultural backgrounds may bring about nonnative plants which remind them of their homelands (Standish et al., 2013). These gardening behaviors promote interaction with nature, which can lead to increased plant diversity, therefore mitigating or slowing declines in some pollinator species (Standish et al., 2013).

Perhaps when armed with the knowledge of which plants are particularly beneficial for various pollinators, residents can make gardening decisions that both fulfill their sense of belonging and encourage pollinator diversity. We know that to stem pollinator losses, more pollinator habitat is needed, and we know urban areas, (especially suburbs and exurbs) could be part of the solution to mitigating pollinator decline. However, we do not know how willing private citizens are to plant pollinator beneficial plants, nor the factors that encourage or discourage said willingness.

Factors Affecting Residents' Yard Management Behaviors

Many studies have assessed residents' willingness to plant trees (Clarke et al., 2013; Conway 2016; Grove et al., 2014; Kirkpatrick et al., 2012; Lin et al., 2017; Locke & Grove, 2014; Smith et al., 2004; Visscher et al., 2014, 2016); other studies have focused on uncovering residents' preferences for wooded vs. grassy yards (Visscher et al., 2016) or native yards vs. nonnative yards (Larson et al., 2008, 2009). Plant composition in the yards of private citizens often depends on parcel size (Lin et al., 2017; Marco et al. 2008; Nassauer et al., 2014; Smith et al., 2005; Visscher et al., 2014) which is related to income and population density which in turn leads to accessibility of ecological resources (Clarke et al., 2013; Grove et al., 2006, 2014; Hope et al., 2003; Kinzig et al., 2005; Martin et al., 2003; Strohbach et al., 2009; Troy et al., 2007; Visscher et al., 2014; Zhou et al., 2009). Residents' yard management behaviors can often be explained from socio-economic status as well as social norms and attitudes within neighborhoods. In fact, since Hope et al.'s groundbreaking research in 2003, which found a link between higher incomes and increased plant diversity in private yards (coined the "luxury effect"), many researchers have shown interest in the opinions and management behavior of private residents regarding plant choice(s) in their yards.

Lifestyle behaviors emerge from the aforementioned social elements, and are exhibited through similarities between yard appearances within neighborhoods (Clarke et al., 2013; Goddard et al., 2012; Grove et al., 2006, 2014; Larson et al., 2009; Locke et al., 2018; Locke & Grove, 2014; Nassauer et al., 2009, 2014; Strohbach et al., 2009; Troy et al., 2007; Visscher et al., 2014, 2016; Zhou et al., 2009). Lifestyle as "ecology of prestige" (Grove et al.,2006), captured by expenditures on yard upkeep (and thus related to income) as well as variables such as age, family composition, importance of social norms and interests in gardening and wildlife also affect what is planted in gardens. Social norms and attitudes about yard aesthetics (Blaine et al., 2012; Conway, 2016; Goddard et al., 2012; Kirkpatrick et al., 2012; Larson et al., 2008, 2009, 2020; Lin et al., 2017; Locke et al., 2018; Van Heezik et al., 2020) suggest that social pressure to sustain membership in one's neighborhood strongly dictates residents' management practices. Blaine et al.'s (2012) Ohio web survey revealed that 62% of residents either treated their lawns themselves or hired a lawn care company to kill weeds. While some residents knew that chemical treatments negatively impact water quality, most perceived it had no effect, and the majority of residents perceived it as a positive impact on neighborhood pride (Blaine et al., 2012).

How Parcel Sizes Affect Plant Choice and Norms in Private Yards

In the Lauris commune of southeastern France, a field collection analysis performed by Marco et al. (2008) found 376 genera and 519 species in the gardens of 120 residents in a rural area undergoing urbanization. Medium and low housing densities (built area 10% to 20% and less than 10%, respectively) were found to have more plant species richness in gardens (heterogeneity) than high density housing (Marco et al. 2008).

In Sheffield, UK, Smith et al. (2005) performed a study which was part of a local project aimed at identifying urban gardens' potential to provide proper ecosystem functioning for biodiversity. Components of said study included measurements of the land cover and garden areas within a parcel (Smith et al., 2005). They found that larger parcels had more plant species richness and this was positively correlated to the capacity for tending multiple garden types on larger parcels (Smith et al., 2005). Additionally, larger parcels tended to have more heterogeneity within the garden, i.e. more garden types including vegetable gardens, trees larger than two meters, and composting piles (Smith et al., 2005). Garden sizes varied from less than one-half meter to more than three meters (Smith et al., 2005).

Visscher et al. (2014) sent postcards to respondents to participate in a web survey in ten Southeast Michigan counties in order to assess which management behaviors, including planting trees, are associated with parcel size, neighborhood norms and demographic characteristics. Parcel sizes were categorized as large (1.3 acres or more), medium (0.4-1.3 acres), and small (0.3 acres or less). Residents with large parcels tended to have more large trees, and seemed to care less about their neighbors' opinions. Medium parcel residents had more trees and planted more trees overall than residents of small parcels, and cared significantly more about their yard fitting in with their neighbors' yards.

Lin et al. (2017), conducted a web survey in Brisbane, Australia which included yard size as a main factor in uncovering whether or not people with more potential for canopy and vegetation cover reflected this in their management choices. Indeed, residents with larger yards had more canopy and vegetation cover.

Socio-economic Characteristics and their Relationship with Plant Choices in Private Yards

Research on the relationship between socio-economic characteristics and plant choice in private yards finds that income is an important factor in neighborhoods. Indeed, Hope et al. (2003) measured variation of woody plant species richness over a rural to urban gradient. Socio-economic variables considered in the study included the average age of people in the home, median income, and population density. These data were collected via the U.S. Census block group data for each area. Hope et al. (2003) found a positive relationship between plant diversity and income. Any income over $50,750 per year (the median income of the study area) exhibited, on average, twice the plant diversity compared to homes under said income (Hope et al., 2003). Hope et al. (2003), therefore pointed to, and coin the term "luxury effect." Higher incomes do not always explain higher plant diversity or abundance on private lawns. In order to try to figure out if income alone, lifestyle, or size of parcel best explain the proportion of the parcel covered in trees, Grove et al. (2014) tested geodemographics in New York, NY. Geodemographics in Grove's study are defined as plant diversity of individual lawns measured alongside socioeconomic status, the luxury effect, population density, and ecology of prestige (defined as land management behaviors influenced by a desire to uphold neighborhood values (Grove et al., 2006). "Ecology of Prestige" was the best predictor to explain canopy tree cover over population density, and the luxury effect previously coined by Hope et al. (2003).

In a study performed simultaneously with Hope et al. (2003), Martin et al. (2003) wanted to know if the socio-economic status of 16 neighborhoods, on a gradient of low-to-high income, within Phoenix, AZ proper were related to residential perennial plant species choice (indigenous vs. nonnative), and its composition therein. Vegetation richness had a positive relationship with median income (Martin et al., 2003). Associated with higher incomes ($67,900 or higher at the time of the study), were native plant types preferred by most residents (Martin et al., 2003). Higher income neighborhoods tended to plant more cacti and succulents compared to trees which were more prevalent in both mid-to-low-income neighborhoods (Martin et al., 2003). Another study comparing cultural and socioeconomic influences across a low-to-high income gradient in Phoenix, AZ by Kinzig and others (2005) found more plant species overall in higher income neighborhoods. Similarly, Strohbach et al. (2009) completed a study in Leipzig, Germany to analyze whether there was a link between socio-economic status and bird diversity. The outcome mirrored the 2003 Hope et al. study in that bird diversity was higher in higher-income residential areas.

Troy et al. (2007) uncovered the fact that higher income neighborhoods with low crime rates exhibited more space for potential plantings and resident stewardship, but higher density, low income and median income populations exhibited the opposite. Additionally, according to Troy et al. (2007), grass lawns require more stewardship and maintenance than trees in Baltimore, MD. A Los Angeles, California study also showed higher incomes to be associated with more vegetated cover (Clarke et al., 2013). When comparing the portion of lawn mown to income in Michigan across a parcel size gradient, Visscher et al. (2014) found income was not a significant factor among any of the parcel size groupings they examined, as higher income residents preferred "turf-style" lawns. In a quantitative study by Zhou et al. (2009), a comparison between residents' behavior, socioeconomic, and other demographic characteristics were matched to yard "greenness." Results showed higher income residents contributed to the "greenness" of lawns (Zhou et al., 2009). Higher income residents were able to afford irrigation and fertilizer management and applications (Zhou et al., 2009).

How do Social Norms and Attitudes Influence Plant Choice and Preferences in Private Yards?

A steadily growing vein of research examines the relationship between human social norms and attitudes and plant cover (or lack thereof) as well as plant species diversity and abundance in private yards.

Larson et al. (2008) assessed "social-ecological dynamics," inherent in urban yards in Phoenix, AZ. They found that altruism (related to positive attitudes about the environment), was the most common attitude. However, the aim to be ecologically/environmentally friendly in landscape management took less priority in a higher-income, historic neighborhood than in the newer, "fringe" neighborhoods consisting of mostly median income residents. Larson et al. (2008) found that not all residents landscaped their yards as a reflection of their own personal tastes, and a majority of residents did not plant native landscapes. Many times, yards were manicured just to appease neighbors, i.e., the choice of what to plant in one's yard seems related to the perception of what neighbors want (Larson et al., 2008). A follow up study in found that most residents cared more about the appearance of their front yards (Larson et al., 2009). Indeed, most residents surveyed preferred either non-native style yards (mesic), or a mix of grassy and native style yards (oasis) in the desert climate (Larson et al., 2009). Fewer people desired native desert yards (xeric), though some chose native style yards for ease of management or ecological purposes, specifically water conservation Larson et al., 2009).

A more recent study from Larson et al. (2020) found patterns between Arizona residents' yard management practices, and bee perceptions. Residents who planted more desert plants in their yards had a higher affinity for bees than those who did not plant desert plants (Larson et al., 2020). Unsurprisingly, residents who used pesticides believed bees were more "problematic" than residents who did not use pesticides (Larson et al., 2020). Herbicide users also viewed bees as more problematic, but no significant difference was revealed between attitudes about bees and herbicide use (Larson et al., 2020).

Blaine et al. (2012) surveyed 432 residents about their private yards in Ohio and found that three factors most affected by landscaping practices were appearance, safety, and the removal or reduction of weeds. Ultimately, appearance seemed to hold more importance over recreation; indeed, over 80% of respondents associated their lawns with beauty and socialization, while over 70% associated lawns with nature observation and recreation (Blaine et al., 2012). In Leeds, UK, Goddard et al. (2012) performed semi-structured interviews to ask people about landscaping practices. Many held their yards as a place reflecting their pride, caring very much about what their neighbors think despite a lack of explicit neighborhood rules, such as those specified by home-owners associations in the United States (Goddard et al., 2012). Some respondents did not conform to this trend of lawn homogeneity in their neighborhoods, as 27% intentionally planted native plants in their yards, and 41% garden to "watch or attract wildlife," (Goddard et al., 2012).

Lin et al.'s 2017 web survey about residents' land cover, parcel size, and plant diversity, uncovered "nature relatedness" (a resident's enjoyment for nature) as a main factor of high plant diversity on large parcels i.e., a resident with ecologically friendly attitudes also significantly contributed to canopy and vegetation cover.

An Australian study found that most surveyed residents who planted trees did so for the sake of appearance (Kirkpatrick et al., 2012). A 2016 study by Conway et al. interviewed residents in Ontario, Canada about their tree-planting preferences. Aesthetics were the top reason given as to why residents chose to plant a tree, and when asked why they would not be planting trees in the future, lack of space was the most common answer (Conway et al., 2016). Locke et al.'s (2018) semi-structured interviews showed that residents of Baltimore, Maryland cared about the "viewable" aspect of front yards, i.e., the appearance of front yards carried more importance than the appearance of backyards, they coined this the "landscape-mullet" concept.

A recent paper from Davis et al. (2021) examines the potential of private exurban residences in Butler County, Ohio to become feeding and nesting sites for pollinators. Residents were asked if they would be willing to plant any of four pollinator-beneficial plant species; *Echinacea purpurea*, wildflower prairie (multiple *spp*.), *Asclepias syriaca*, and *Monarda fistulosa* (Davis et al., 2021). Percentages of stated willingness to "add in the next year" by species were 11.2%, 10.3%, 5.9%, and 6.5%, respectively (Davis et al., 2021). Compare this to the 41% who were unwilling to add any of the plant species, and more questions about the motivating factors of residents' yard preferences need further exploration.

Lifestyle

Grove et al. 's 2006 vegetation study in Baltimore, Maryland, focused on PROWS (Public Right of Way) found that "lifestyle behavior" was a statistically more significant predictor variable of vegetation cover than age and income. Lifestyle behavior was defined as a resident's desire to retain a sense of membership in their community, therefore influencing their yard management practices.

Visscher et al.'s (2014) assessment of parcel size and neighborhood density in Southeast Michigan, found the most significant independent variable among mown lawns of yards consisting of all parcel sizes was correlated to the presence or absence of children in the home. Clearly yard vegetation choice is influenced by the age of household members. Visscher et al. (2016) performed a subsequent study relating wooded yards to carbon storage potential. Residents' yard use and social norms were gauged with their preferences of "wooded front yards and backyards," by asking them to choose an image of a preferred front yard and backyard landscape. (Visscher et al., 2016). Various options were available among the following categories for front yards and backyards: "Woodland Style," "Backyard Woodland Style," "Turf and Tree Style," and "Turf Style." (Visscher et al., 2016). Resident preferences were 27.4%, 8.1%, 35.5%, and 29.0% respectively. Of course, those residents who preferred more wooded front yards were also less likely to mow large portions of their yards, leading to a higher potential for carbon storage (Visscher et al., 2016).

Lifestyle, social norms, and socio-economic status are all related to planting and yard management decisions. As more urban ecologists research private gardens and integrate social norms, lifestyle, income and land cover data, we can uncover how best to market pollinator beneficial plants to residents. These data may impact urban planning as well as help residents make informed decisions about lawn care, plant care and ultimately promoting more biodiverse human dominated landscapes.

Research Objectives and Hypotheses

The overarching objective of this study is to gauge the public's acceptance of voluntarily planting native plants in their yards. In order to learn residents' willingness to plant pollinator beneficial plants in Darke County and Miami County, Ohio, we needed to assess planting preferences, as well as yard management, behaviors, social norms and values, and personal preferences of residents. Additionally, we need to ascertain property values, socioeconomic information, and parcel sizes.

Specifically, we wanted to reveal which of the following social theories: lifestyle, the luxury effect, or population density; best predict respondents' stated willingness to plant three pollinator beneficial plants: *Asclepias syriaca*, *Echinacea purpurea*, and wildflowers (multiple *spp*.) and allow two naturalized species known as beneficial for pollinators: *Trifolium repens*, and *Taraxacum officinale*. Subsequently, for the residents who were willing to convert some of their parcels to at least one of the pollinator beneficial plant species shown in the survey, we wish to ascertain which of the aforementioned social theories best predict the amount of land residents are willing to convert.

Methods

Study Area and Sampling Method

Our study area is within the Dayton-Springfield-Sidney Combined Statistical Area in Southwest Ohio. Specifically, Darke County is situated on the western border of Ohio, and Miami County is East and Southeast of Darke County (Figure 1). The focus here is on areas across a suburban to rural gradient. Darke County's 2019 population estimate was 51,113, and Miami County's 2019 estimated population was 106,987 (U.S. Census Bureau). Darke County's 2010 population per square mile estimate was 88.5, and Miami County's 2010 population per square mile estimate was 252.1 (U.S. Census Bureau).

51,237 properties were identified by four criteria: (1) residential, (2) occupied, (3) less than 30-acre parcels, and (4) located in Miami or Darke counties in Ohio. (U.S.A.). We randomly selected 200 properties according to two strata: income and parcel size. These households received a questionnaire (Appendix A) that shows pollinator beneficial plants native to the U.S.A. of differing appearance, management, and pollinator service and include purple coneflower (*Echinacea purpurea*), common milkweed (*Asclepias syriaca*), and wildflowers (multiple *spp.*), as well as two species commonly found in lawns in the study area: *Trifolium repens*, and *Taraxacum officinale*.

Survey

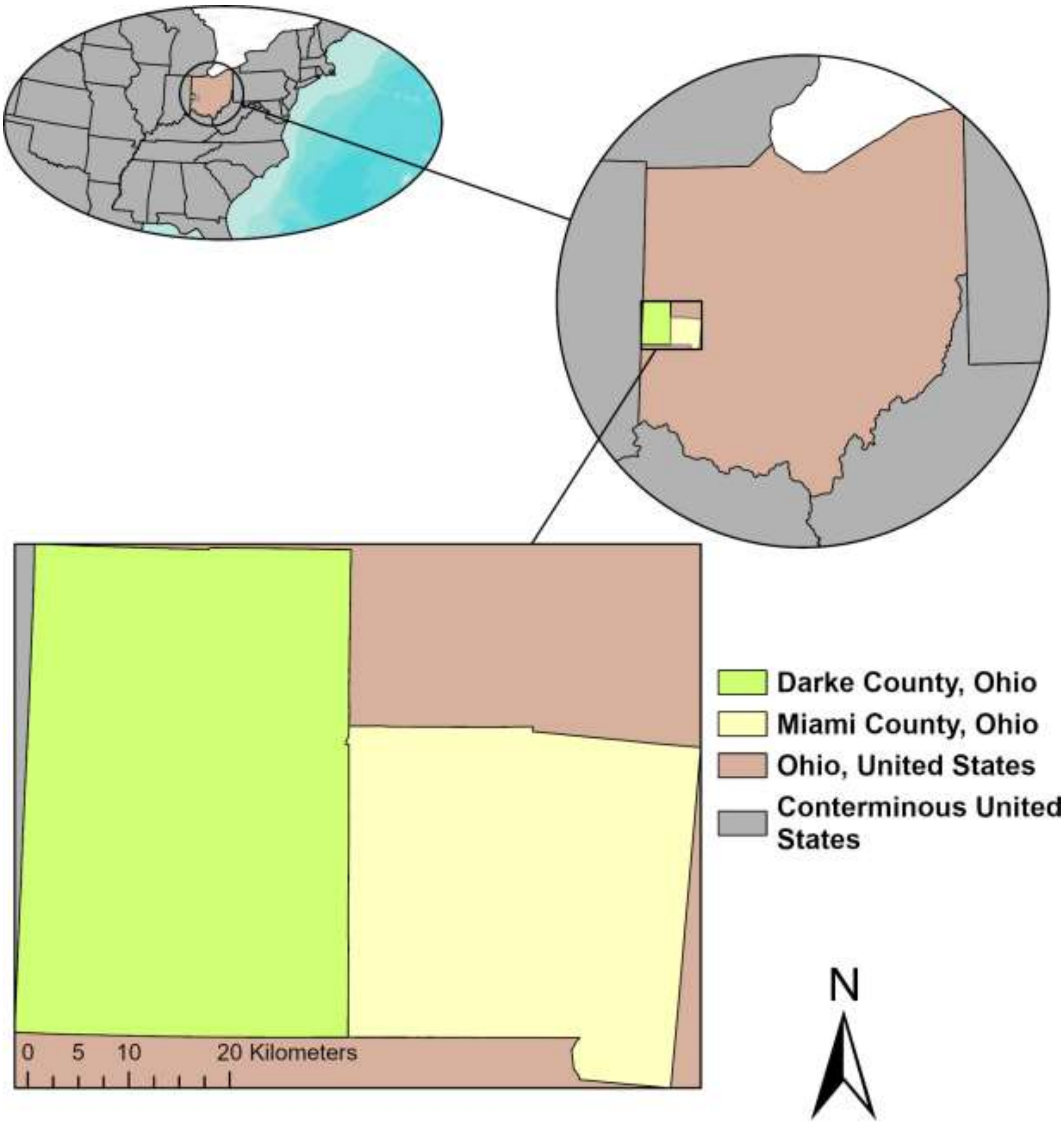
The first section of the survey instrument (Appendix A1) consisted of questions about three specific pollinator beneficial plants: the Purple Coneflower (*Echinacea purpurea*), wildflowers (multiple *spp.*), and Common Milkweed (*Asclepias syriaca*). The order of plant images was rotated using three different configurations so as not to introduce order bias (Dillman et al., 2014). The initial question asked which of the three plants the respondent found the most beautiful. Answers included the common and scientific names of the plants, as well as a picture of each, and the option to choose that *none* of the landscapes were beautiful.

Pages two through four (Appendix A2-A4) showed the image of each plant, and gave information to the respondent about the bloom time, height, and spread of each. Questions asked the respondent why they would or would not like to see each plant in their yards. The next eight questions based on plant choices were answered on a 5-point likert scale of "Strongly Disagree," "Disagree," "Neither Agree Nor Disagree," "Agree," and "Strongly Agree." Questions asked respondents about knowledge of each plant and willingness to plant each plant in the following order: 1) know how to plant, 2) how to care for, 3) where to purchase seed, 4) will add (or add more) to yard next year, 5) will add (or add more) next time changes are made to landscape, 6) likely add with help of seed cost, 7) likely add if online resources regarding purchase, planting and care are received, and 8) likely add if help with labor is received. Questions four through eight determined our willingness to plant indices for the three main species in this study.

Pages five and six (Appendix A5-A6) consisted of instructions on how to fill out the map we provided of each respondents' property as well as questions about landscaping practices. The

Figure 1

Map of Study Area



Note. Darke County, and Miami County, Ohio (lower left) relative to the State of Ohio, and the State of Ohio (middle right) relative to Conterminous United States (top left). Base map imagery provided by Esri, NOAA, and USGS. GIS Shapefiles provided by https://www.data.gov/

map instructions indicated to the respondent how to draw areas where they intended to plant one or all (if any) of the three pollinator beneficial plants, and where they intended to plant trees (if any). The landscaping practices section asked an array of questions regarding which types of land cover were present in respondents' yards. This section also encompassed questions regarding the respondents' attitudes, and social norms associated with landscaping practices.

Page seven (Appendix A7) consisted of parcel characteristics. Respondents were asked another array of questions, but this time regarding the presence of garden types, fertilizer and pesticide applications, presence or absence of a pond on the property, whether or not they owned a zero-turn radius mower or tractor, and whether or not they would like to see more of certain pollinators or their property. Additionally, respondents were asked about the presence or absence of multiple weed species that are known to be beneficial for pollinators.

The eighth and final page (Appendix A8) asked for demographic information with a reminder that the information would only be used for statistical purposes, and individual responses would remain confidential. Questions asked to respondents involved how long they have lived in the home, year built as well as others regarding specific agreements such as homeowners associations or conservation easements. Social stratification variables included age, employment status, marital status, level of education, year respondent was born, gender, race/ethnicity, and last year's total household income. The survey ended with an optional section to share any final comments as well as an option to write their email address in order to share any resources created as a result of the survey.

We obtained approval prior to conducting the research through Miami University's Institutional Review Board (IRB). Our project reference number is 03270e.

Survey package contents

Prior to dropping off surveys, clear plastic bags were stuffed with a survey and a cover letter with the county name (Miami County or Darke County), explaining the respondent's rights to anonymity and IRB compliance information, as well as contact information for questions about the survey. In addition to the survey, a map of the respondent's parcel was included. Each survey packet included a map of the property boundaries and underlying recent (Ohio Geographically Referenced Information Program, 2017, 2018) high spatial resolution aerial photo. The Miami County data were downloaded for 2017 at six-inch spatial resolution while the Darke County data were obtained for 2018 at one-foot spatial resolution. All parcels were displayed to include the entire parcel on 8.5 by 11 in. or 11 by 17 in. pieces of paper in full color.

Survey drop-off and mail-in procedures

Surveys were dropped off or left with respondents in Darke and Miami County, Ohio. Selected residents were contacted up to four times total. All initial surveys were distributed from mid-July to mid-August 2019. The first contact consisted of dropping off the survey at people's homes. If a resident did not answer, the bag was hung on the doorknob for the respondent to find later. The second contact consisted of a postcard, sent to all respondents, thanking those who took the survey and gently "nudging" those who did not, to please take the survey. The third contact consisted of another copy of the survey mailed to all the non-respondents two weeks after the second contact. The fourth and final contact was another reminder and thank you postcard. The postcard emphasized the importance of the residents' individual answers and explained this was the last time we were going to be contacting them. The verbiage for the contact letters and postcards followed examples found in Dillman et al. (2014).

Data entry of surveys

All survey data were entered into an online-version of the survey which we created in Qualtrics (2019). Any maps returned with the surveys were scanned using a flat-belt scanner at 300 dpi. The images were then georeferenced using the property boundaries. Finally, all areas drawn on the map were digitized and assigned to their respective parcels. Trees were digitized as points, while areas to be potentially converted to pollinator beneficial plantings (m^2) were digitized as polygons.

Spatial Analysis

Spatial analyses were performed in ArcGIS Pro version 2.3-2.7 (Esri, 2019, 2020, 2021) to digitize the aforementioned polygons and points as well as obtain three population density variables (housing density at 500 m^2, housing density at 1 km^2, and distance (*ft*) to agglomerations of more than 10,000 inhabitants). Darke County and Miami County parcel data were selected for attributes described as both residential and containing single-family homes. Parcel boundaries within the two counties were converted to central X and Y coordinate points and merged into one layer. Housing density was calculated based on the number of parcels within each buffer range (500 *m* or 1 *km*). Euclidean distances to agglomerations of more than 10,000 inhabitants from the location of respondents were identified via an Esri (2019) population database.

Statistical Methods

Random forests is a machine learning algorithm equipped to handle both categorical and continuous variables (Breiman, 2001). A set number of right-hand side (RHS) variables are randomly split from the data set to create prediction trees and determine which variables are most important to correctly predict the left-hand side (LHS) variable (Breiman, 2001). Additionally, random forests can predict both linear and non-linear patterns within nonparametric data sets (Genuer, R. & Poggi, J-M, 2020; Sage, 2018). In this study, seven random forest models were implemented to indicate which variables (Table 1) representing three social theories, i.e., lifestyle (Grove et al., 2006), luxury effect (Hope et al., 2003; Martin et al., 2004), or population density, were the strongest predictor variables of respondents' willingness to plant pollinator beneficial plants. The first three sets of models consisted of survey responses stating a willingness to plant one or more of the following three pollinator beneficial plants, wildflowers, *Echinacea purpurea*, or *Asclepias syriaca* as LHS variables. The fourth set of models consisted of the parcel area (m^2) respondents were willing to convert to pollinator beneficial plants in total as a LHS variable. Three final sets of models represented residents that were asked, on a five-point Likert scale, their willingness to allow two naturalized species, *Trifolium repens*, and *Taraxacum officinale* to grow in their front yards and their backyards. LHS variables included willingness to allow *T. repens* to grow in the front yard, willingness to allow *T. repens* to grow in the backyard, and willingness to allow *T. officinale* to grow in both front and backyards. This ascertained which RHS variables (described in the previous paragraph) explain willingness to allow each naturalized species to grow in their yards, as well as ascertain whether or not parcel attributes have an effect on these variables. Statistical analyses were performed in R (R Core Team, 2021) via the randomForest package (Liaw & Weiner, 2002).

Table 1

Summary statistics for variables used in the random forest models.

Variable Description	Symbol	*M*	*SD*	*SE*	Median	Min.-Max
Willingness to plant *Asclepias syriaca*	---	2.39	0.95	0.09	2.4	1 - 5
Willingness to Plant *Echinacea purpurea*	---	2.76	0.91	0.09	3	1 - 4.8
Willingness to Plant Wildflowers	---	2.8	0.95	0.09	3	1 - 5
Willingness to Convert (m^2)	---	1,672	3,030	412	465	10 - 16,788
Willingness to Allow *Taraxacum officinale*	---	2.44	1.22	0.12	2	1 - 5
Willingness to Allow *Trifolium repens* in front yard	---	2.56	1.24	0.12	2	1 - 5
Willingness to Allow *Trifolium repens* in backyard	---	2.85	1.24	0.12	3	1 - 5
I want my Backyard to Look Neat and Tidy	BackyardTidy	4.15	0.73	0.07	4	1 - 5
I think my Yard is a Reflection of Me	Reflection	3.84	0.95	0.09	4	1 - 5
I enjoy mowing	Mowing	3.6	1.09	0.11	4	1 - 5
I enjoy gardening	Gardening	3.75	1.08	0.11	4	1 - 5
I enjoy planting trees	PlantTrees	3.62	1.06	0.1	4	1 - 5
I enjoy being outside	Outside	4.4	0.8	0.08	5	1 - 5
Do you have any pets that spend time in your yard? (Yes/No)	Pets	1.26	0.44	0.04	1	1 - 2
How many years have you lived in your current home?	#YearsInHome	18.81	12.21	1.15	18.5	0 - 55
How many people live in your home (including you) that are age 18 or older?	#OfAdults	2.26	0.93	0.09	2	0 - 6

Table 1 (*cont'd*)

Summary statistics for variables used in the random forest models

Variable Description	Symbol	*M*	*SD*	*SE*	Median	Min.-Max
How many people live in your home that are younger than age 18?	#OfChildren	0.66	1.17	0.11	0	0 - 7
What is the highest level of education that you have completed?	Education	4.95	1.76	0.17	5	1-7
In what year were you born? (years)	YearBorn	1959	12.68	1.24	1960	1926 - 1989
Assessor's Market Valuation of Property (USD)	HomeValue	338,181	14,670	64,900	291,800	64,900 716,500
Parcel Size (m^2)	ParcelSize	55,581	3,280	783	51,035	783- 119,294
Distance to > 10,000 people (*ft*)	DistToUrban	35,688	1,766	8,151	32,557	8,151 - 86,332
Housing Density (1 km^2 w/in 1 *km* radius)	Dens1km	864.82	94.87	76.39	469.83	76.39 - 5,105
Housing Density (500 m^2)	Dens500m	197.9	35.7	5.09	61.12	5.09 - 2,012

Note. *M*, *SD*, and *SE*, stands for mean, standard deviation, and standard error, respectively. These data are for the full dataset (113 respondents). Units are specified in parenthesis after the variable description except when the data are on a 5-pt Likert-scale with 1 = Strongly Disagree, 2 = Disagree, 3 = Neither Agree Nor Disagree, 4 = Agree, and 5 = Strongly Agree.

Random forests can only be implemented with complete cases unless the missing data are imputed (Liaw & Weiner, 2002; Sage, 2018; Genuer, R. & Poggi, J-M, 2020). However, a fairly recent PhD dissertation from Iowa State University, comparing variable importance methods of random forests suggested imputation methods are not recommended for Likert-scale data, as it can cause a large overestimate of the out-of-bag error rate (Sage, 2018). Since approximately 35% of the RHS variables contain five-point Likert scale responses (Table 1) and the scope of this study gauges human interests on a fine geographical scale, imputation techniques were not used, and records with missing survey data were removed (i.e., observations in which respondents did not answer survey questions that intersected with any of our RHS variables).

Variable importance plots were generated representing the Mean Decrease in Accuracy (IncMSE%), defined by the percentage of error that would occur if any one of the RHS variables at each node were removed in the random forest model. RHS variables in all random forest models remained the same (Table 1). Each random forest series generated 100 cycles of training data, tuned to accommodate the parameters of each dataset if necessary. RHS variables that revealed a positive Mean Decrease Accuracy (IncMSE%), were plotted against each potential LHS variable to analyze partial dependencies. Finally, multiple regression analyses with a backward selection approach were performed on each dataset to model the effects of willingness to plant or to convert parcel areas of each species.

Bivariate spearman-rank correlations were performed on all LHS and RHS variables via the psych package (Revelle, 2020), to check for collinearity. Welch's Two-sample t-tests (Table 2) were performed on each random forest dataset to check for significant differences in the means of the full dataset convert a portion of their parcel to pollinator beneficial plants (n=54). Bartlett's Tests for Homogeneity were performed to test for unequal variances prior to the test of difference of means (Table B3).

Table 2

Welch's Two-Sample t-test between the full dataset and the dataset used in the random forest models where incomplete surveys were removed.

Variables		Full	Reduced	95% CI				
LHS	RHS	*M*	*M*	*LL*	*UL*	*t*	*df*	*p*
Willingness to plant Wildflowers (multiple *spp.*)	I want my backyard to look neat and tidy	4.15	4.11	-0.18	0.24	0.32	186.98	0.75
	I enjoy planting trees	3.62	3.61	-0.30	0.31	0.03	185.56	0.98
	I enjoy being outside	4.4	4.4	-0.23	0.23	0.00	185.21	1.00
	In what year were you born?	1959.63	1959.66	-3.64	3.59	0.01	187.86	0.99
	County Assessor's Valuation of the Property (USD)	338181.70	333185.40	37198.87	47191.35	0.23	195.02	0.82
	Distance (ft) to agglomerations with ≥ 10,000 population density	35687.84	36088.36	-5603.67	4802.64	0.15	191.78	0.88
	Housing Density (1 km² within a 1 km radius)	864.82	844.62	-261.07	301.47	0.14	190.85	0.89

Note. LHS = left-hand side variable, RHS = right-hand side variable, M = mean, CI = confidence interval, LL = lower limit, UL = upper limit, *Spp*. = several species. Units are specified in parenthesis after the variable description except when the data are on a 5-pt Likert-scale with 1 = Strongly Disagree, 2 = Disagree, 3 = Neither Agree Nor Disagree, and 5 = Strongly Agree.

Table 2 (*cont'd)*

Welch's Two-Sample t-test between the full dataset and the dataset used in the random forest models where incomplete surveys were removed.

Variables		Full	Reduced	95% CI				
LHS	RHS	(*M*)	(*M*)	*LL*	*UL*	*t*	*df*	*p*
Willingness to Plant *E. purpurea*	I want my backyard to look neat and tidy	4.15	4.11	-0.18	0.24	0.32	186.98	0.75
	I enjoy planting trees	3.62	Variables	-0.29	0.32	0.10	185.5	0.92
	I enjoy being outside	4.4	4.4	-0.23	0.23	0.00	185.21	1
	In what year were you born?	1959.63	1959.34	-3.34	3.90	0.15	187.69	0.88
	County Assessor's Valuation of the Property	35687.84	36505.97	-6004.42	4368.17	-0.31	192.24	0.76
	Distance to agglomerations with ≥ 10,000 population density	864.82	824.267	-237.74	318.85	0.29	192.39	0.77
	Housing Density (1 km^2)	338181.7	337226.2	-41803.85	43714.77	0.04	193.28	0.96

Note. LHS = left-hand side variable, RHS = right-hand side variable, M = mean, CI = confidence interval, LL = lower limit, UL = upper limit. Units are specified in parenthesis after the variable description except when the data are on a 5-pt Likert-scale with 1 = Strongly Disagree, 2 = Disagree, 3 = Neither Agree Nor Disagree, and 5 = Strongly Agree.

Table 2 (cont'd)

Welch's Two-Sample t-test between the full dataset and the dataset used in the random forest models where incomplete surveys were removed.

Variables		Full	Reduced	95% CI				
LHS	RHS	(M)	(*M*)	*LL*	*UL*	*t*	*df*	*p*
Willingness to plant *A. syriaca*	I want my backyard to look neat and tidy	4.15	4.10	-0.17	0.25	0.40	183.55	0.69
	I enjoy being outside	4.40	4.39	-0.22	0.25	0.11	181.15	0.91
	How many years have you lived in your current home?	18.81	18.89	-3.55	3.40	-0.04	184.83	0.97
	County Assessor's Valuation of the Property	338181.70	334816.9	-39278.34	46007.84	0.16	190.88	0.88
	Housing Density (1 km^2)	864.82	831.48	-248.10	314.78	0.23	187.89	0.82

Note. LHS = left-hand side variable, RHS = right-hand side variable, M = mean, CI = confidence interval, LL = lower limit, UL = upper limit. Units are specified in parenthesis after the variable description except when the data are on a 5-pt Likert-scale with 1 = Strongly Disagree, 2 = Disagree, 3 = Neither Agree Nor Disagree, and 5 = Strongly Agree.

Table 2 (cont'd)

Welch's Two-Sample t-test between the full dataset and the dataset used in the random forest models where incomplete surveys were removed.

Variables		Full	Reduced	95% CI				
LHS	RHS	(*M*)	(*M*)	*LL*	*UL*	*t*	*df*	*p*
Area willing to convert (m^2)	How many years have you lived in your current home?	18.52	18.30	-4.09	4.52	0.10	0.10	0.92
	In what year were you born?	1962.25	1961.52	-3.35	4.82	0.36	110.1	0.72
	Distance to agglomerations with ≥ 10,000 population density	37524.42	37621.81	-6431.29	6236.49	-0.03	110.91	0.98
	Housing Density (1 km^2)	782.12	711.55	-241.16	382.29	0.45	113.98	0.65

Note. LHS = left-hand side variable, RHS = right-hand side variable, M = mean, CI = confidence interval, LL = lower limit, UL = upper limit. Units are specified in parenthesis after the variable description except when the data are on a 5-pt Likert-scale with 1 = Strongly Disagree, 2 = Disagree, 3 = Neither Agree Nor Disagree, and 5 = Strongly Agree.

Results

Out of 200 surveys distributed, we received 113 responses (57% response rate). Twenty percent of respondents stated they would add (or add more) wildflowers, and 20% stated they would add (or add more) *E. purpurea* in the next year (Figure 2). Only 8% of respondents stated they would be willing to add (or add more) *A. syriaca* in the next year with 45% of respondents who stated they disagree and strongly disagree to add (or add more) in the next year (Figure 2).

Fifty-five percent of respondents returned surveys with maps (n=62) illustrating how much of their parcel they were willing to convert to any of the pollinator beneficial plant species shown in the survey. Miami County and Darke County, Ohio residents stated they were willing to convert a total of 129,579 m^2 to one or more of the pollinator beneficial plants in our study. Respondents who stated they would convert a portion of their parcel to pollinator beneficial areas were most likely to convert to wildflowers compared to, *E. purpurea*, and *A. syriaca*. Indeed, the area they drew on the maps to devote to wildflowers totaled 59,344 m^2 (46%), while only 7,163 m^2, (6%) and 3,258 m^2 (3%), would be devoted solely to *E. purpurea* and *A. syriaca*, respectively. Areas potentially dedicated to mixes of all three species totaled 55,364 m^2 (42%), and areas potentially dedicated to mixes of two species totaled 4,450 m^2 (3%).

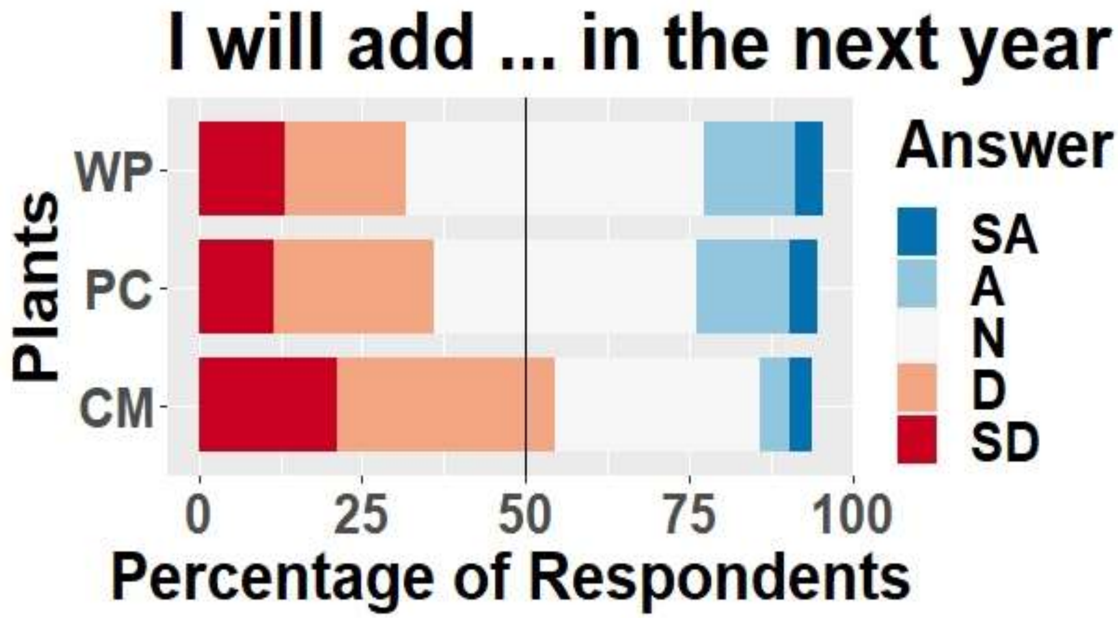
Willingness to Plant Wildflowers

Random Forest Results for Willingness to Plant Wildflowers

According to the random forest model, the most important LHS variables which explained our respondents' willingness to plant wildflowers were county assessor's valuation of the property (USD), housing density (defined as dwellings per km² within a 1 km radius), distance (*ft*) to agglomerations of more than 10,000 people (*ft*), "I like to keep my backyard neat and tidy", "I enjoy planting trees," "I enjoy being outside," "I have animals that spend time in my backyard," and year the respondent was born (years) (Figure 3). Willingness to plant wildflowers had a positive non-linear relationship with the county assessor's valuation of the property (Figure 4). Residents of properties valued below $200,000 were much less willing to plant wildflowers, while residents of properties valued above $600,000 were the most willing to plant wildflowers (Figure 4). Willingness to plant wildflowers had a negative non-linear relationship with housing density measured within a 1 *km* radius (Figure 4). Residents living in neighborhoods with less than 500 dwelling units per km^2 (within a 1 km radius), were more willing to plant wildflowers (Figure 4).

Figure 2

Percentage of Residents Willing to Add Pollinator Beneficial Plants in the Next Year.



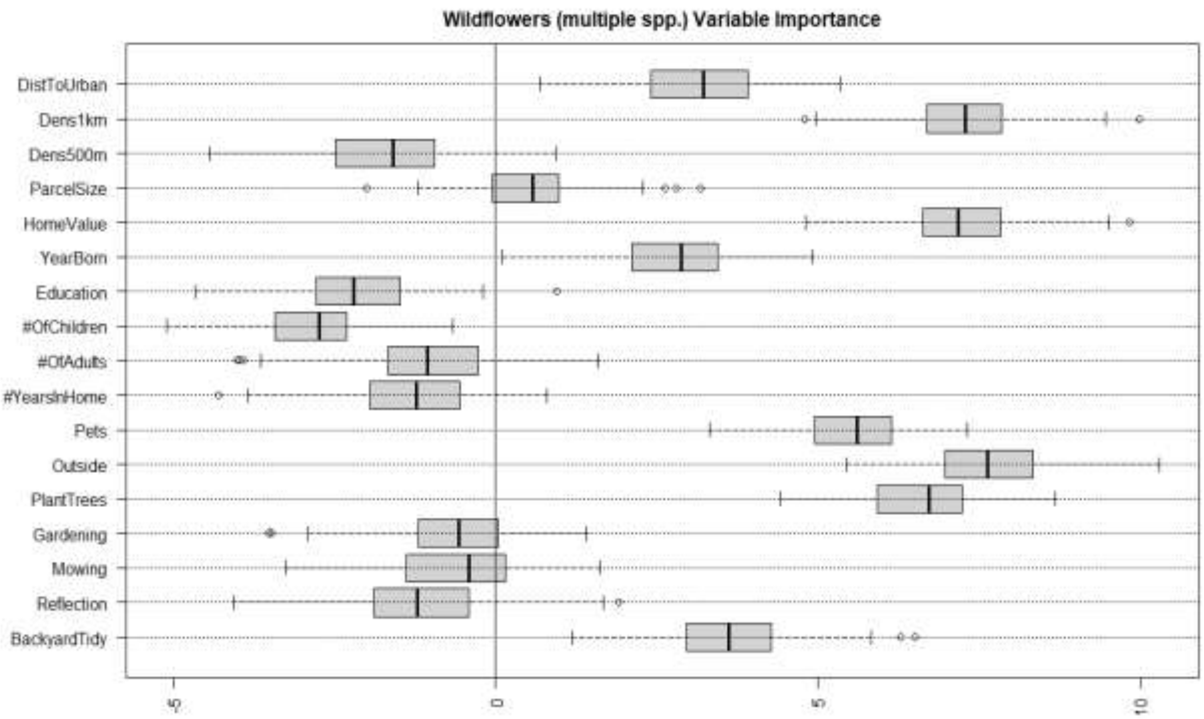
Note. WP = Wildflowers (multiple spp)., PC = Purple Coneflower (Echinacea purpurea), CM = Common Milkweed (Asclepias syriaca). SA = Strongly Agree, A = Agree, N = Neutral, D = Disagree, SD = Strongly Disagree.

Residents living in neighborhoods with more than 950 dwelling units per *km²* (within a 1 *km* radius) were less willing to plant wildflowers, as overall willingness takes a nose-dive (Figure 4).

Willingness to plant wildflowers had a positive non-linear relationship with distance (*ft*) to agglomerations of more than 10,000 people (Figure 4). For properties within 20,000 *ft* of urbanized areas, residents are substantially less willing to plant wildflowers (Figure 4). Willingness to plant wildflowers had a positive linear relationship with residents who state they enjoy being outside, and they enjoy planting trees (Figure 4). Residents who specified they have pets that spend time in their yards, were more willing to plant wildflowers than residents who stated they did not have pets that spend time in their yards (Figure 4). Willingness to plant wildflowers had a negative linear relationship with residents who strongly preferred to keep their backyards neat and tidy (Figure 4). Finally, we uncovered a positive but non-linear effect between willingness to plant wildflowers and the resident's birth year (Figure 4). Residents born before 1949 were substantially less willing to plant wildflowers than respondents born after 1949 (Figure 4).

Figure 3

Boxplot of Variable Importance Measures Explaining Willingness to Plant Wildflowers (multiple spp.)



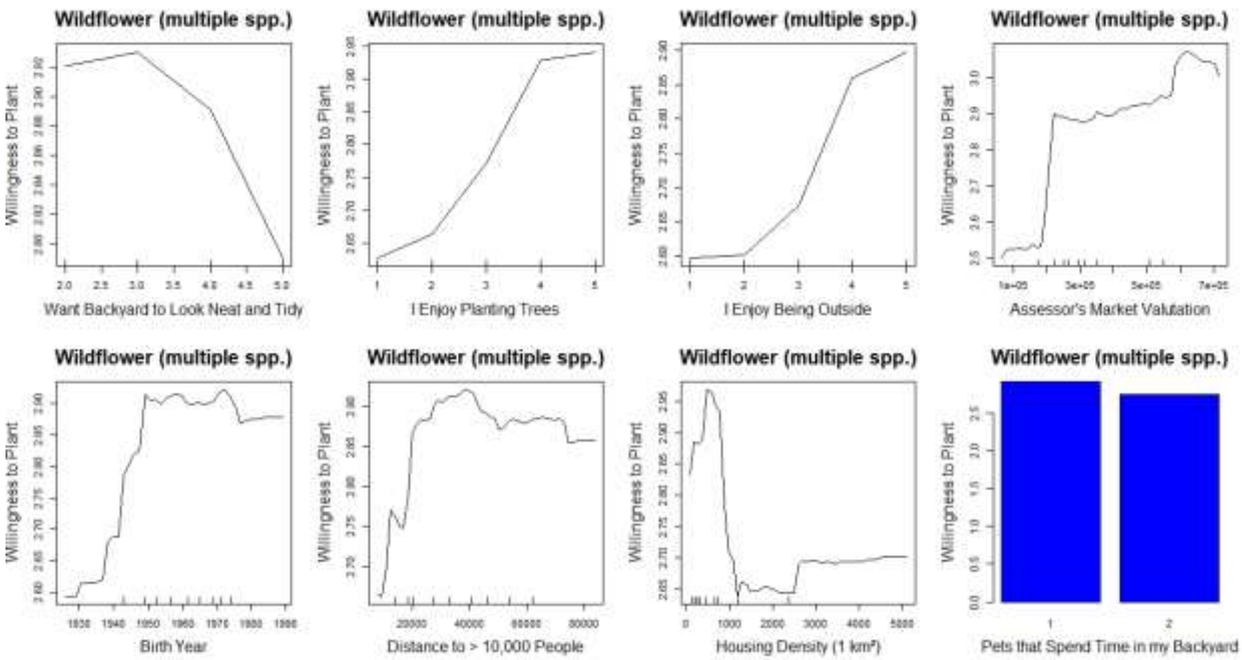
Note. Result of 100 random forest runs. Variable names can be found in Table 1.

Multiple Regression Model to Explain Willingness to Plant Wildflowers

The variables identified by the random forest models as consistently more important in explaining willingness to plant wildflowers (Figure 3) were then entered in a multiple regression model. This model ($R^2 = 0.23$, $F(3, 86) = 8.36$, $p < .001$) found that willingness to plant wildflower was best explained by, enjoy planting trees, want the backyard neat and tidy, and the county assessor's valuation of the property (Table 4). Self-stated enjoyment of planting trees was positively and significantly related to respondents' willingness to plant wildflowers, but those who stated they like to keep their backyards neat and tidy were significantly less willing to plant wildflowers.

Figure 4

Partial Dependencies between Willingness to Plant Wildflowers (multiple spp.) and the most important RHS variables in the random forest models



Note. RHS = right-hand side variables. Likert scale variables: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly Agree. Binary variables (Pets that Spend Time in my Backyard): 1 = Yes, 2 = No

Willingness to Plant *Echinacea purpurea*

Random Forest Results for Willingness to Plant Echinacea purpurea

A second random forest model resulted in seven important LHS variables for willingness to plant *Echinacea purpurea* (Figure 5). These were County assessor's valuation of the property (USD), housing density (number of dwellings per km^2 (within a 1 *km* radius), distance to agglomerations of more than 10,000 people (*ft*), year the respondent was born (years), enjoy being outside, enjoy planting trees, and want the backyard to look neat and tidy (Figure 5).

Willingness to plant *E. purpurea* revealed a positive non-linear trend with the County Assessor's valuation of the property (Figure 6). Properties valued below $200,000, housed residents who were less willing to plant *E. purpurea*; while for those above $600,000 residents

Table 4

Regression Model Results

RHS Variable	LHS Variable Category	LHS Variable	Beta Coefficient	*SE*	*p*
Willingness to plant wildflowers	Lifestyle and norms	I want my backyard to look neat and tidy	-3.49E-01	1.18E-01	0.004**
		I enjoy planting trees	3.04E-01	7.92E-02	0.000***
	Luxury Effect	Assessor's Market Valuation of the Property	1.26E-06	5.95E-07	0.036*
Willingness to plant *E. purpurea*	Lifestyle and norms	I want my backyard to look neat and tidy	-0.341	0.116	0.004**
		I enjoy planting trees	0.276	0.077	0.000***
Willingness to plant *A. syriaca*	Lifestyle and norms	I want my backyard to look neat and tidy	-3.83E-01	1.25E-01	0.012**
		I enjoy being outside	3.28E-01	1.11E-01	0.004**
	Luxury Effect	Assessor's Market Valuation of the Property	1.32E-06	6.13E-07	0.033*
	Population Density	Housing Density (1 kilometer)	-2.47E-04	9.47E-05	0.011*
Area willing to convert (*m^2*)	Willing to Plant (All *spp.*)	How many years have you lived in your current home?	-0.053	0.44	0.011*
Willingness to allow *T. repens* to grow in front yard	Lifestyle and norms	I want my backyard to look neat and tidy	-2.29E-01	6.84E-02	0.001**
	Population Density	Housing Density (1 kilometer)	-1.26E-04	3.40E-07	0.017*
	Luxury Effect	Assessor's Market Valuation of the Property	-7.71E-07	5.15E-05	0.025*

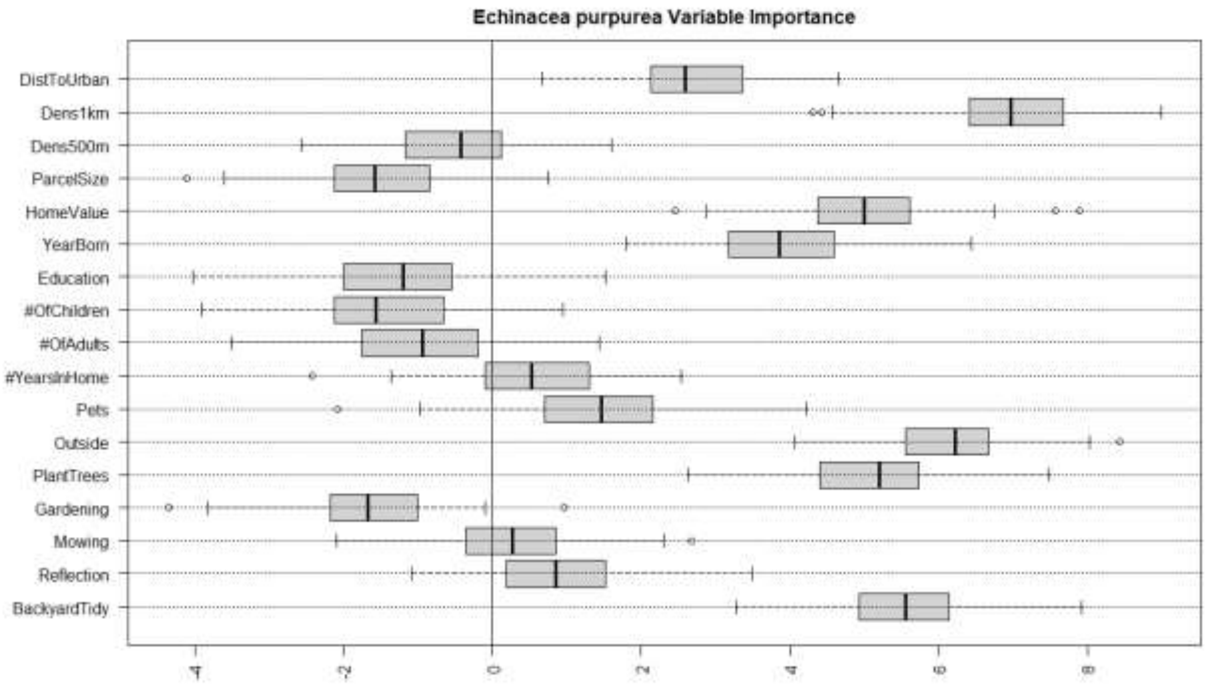
Willingness to allow *T. repens* to grow in backyard	Lifestyle and norms	I want my backyard to look neat and tidy	-0.59	0.16	0.000***
		I enjoy being outside	0.44	0.15	0.003**
Willingness to allow *T. officinale* to grow	Lifestyle and norms	I want my backyard to look neat and tidy	-5.13E-01	1.63E-01	0.002**
	Luxury Effect	County Assessor's Market Valuation of the Property	-2.24E-06	8.03E-07	0.007**

*p < .05. **p < .01. ***p < .001.

Note. RHS = right-hand side variables, LHS = left-hand side variables.

Figure 5

Boxplot of Variable Importance measures explaining Willingness to plant Echinacea purpurea.

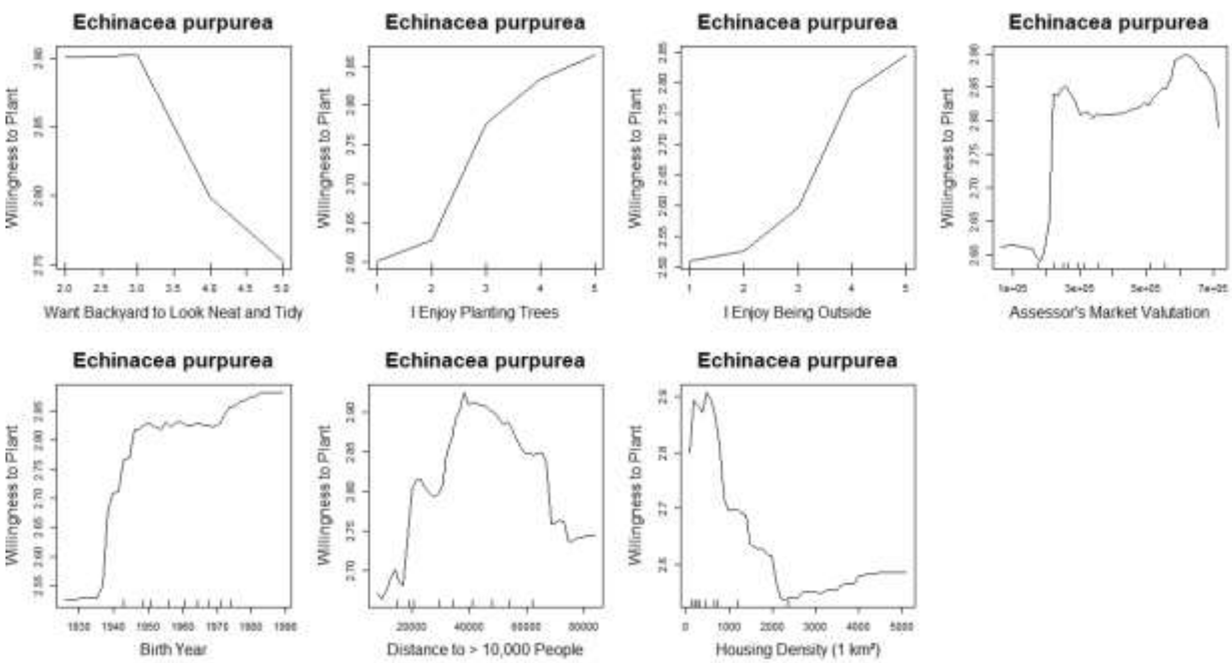


Note. Result of *100 random forest runs. Variable names can be found in Table 1.*

were much more willing to plant *E. purpurea* (Figure 6). Willingness to plant *E. purpurea* also showed a negative non-linear relationship with housing density measured within a 1 *km* radius. (Figure 6). Above 800 dwellings per *km²* (within a 1 *km* radius), residents' willingness to plant *E. purpurea* dropped. Residents' willingness to plant *E. purpurea*, was highest when residents lived 41,000 *ft* to agglomerations of more than 10,000 people. (Figure 6). Residents who lived less than 20,000 *ft* and more than 60,000 *ft* to agglomerations of more than 10,000 people were less willing to plant *E. purpurea* (Figure 6). A non-linear positive relationship was uncovered between the year the respondents were born and willingness to plant *E. purpurea* (Figure 6). Residents born before 1947 were considerably less willing to plant *E. purpurea* (Figure 6). Willingness to plant *E. purpurea* was positively and linearly related to the residents who enjoy being outside and enjoy planting trees (Figure 6). In contrast, those who report wanting their backyards neat and tidy were less willing to plant *E. purpurea* (Figure 6).

Figure 6

Partial Dependencies between Willingness to Plant Echinacea purpurea and the most important RHS variables in the random forest models.



Note. RHS = right-hand side variables. Likert scale variables: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly Agree.

Multiple Regression Model to Explain Willingness to plant Echinacea purpurea

Effects of willingness to plant *Echinacea purpurea* ($R^2 = 0.19$, $F(2, 87) = 10.32$, $p < .001$) were similar with wildflower prairie, since, “I enjoy planting trees,” and “I like to keep my backyard neat and tidy,” best predict willingness to plant *E. purpurea*, though County assessor’s valuation of the property did not play a significant role this time (Table 4). Residents who like keeping their backyards neat and tidy had a stronger, negative effect on willingness to plant *E. purpurea* compared to residents who enjoy planting trees (although that effect was positive). (Table 4).

Willingness to Plant *Asclepias syriaca*

Random Forest Results for Willingness to Plant Asclepias syriaca

The most consistent important RHS variables that explain willingness to plant *Asclepias syriaca* were county assessor's valuation of the property (USD), housing density (number of dwellings per km^2 within a 1 km radius), how long (years) the resident had occupied the home, have pets that spend time in yard, enjoy being outside and want backyard to look neat and tidy (Figure 7).

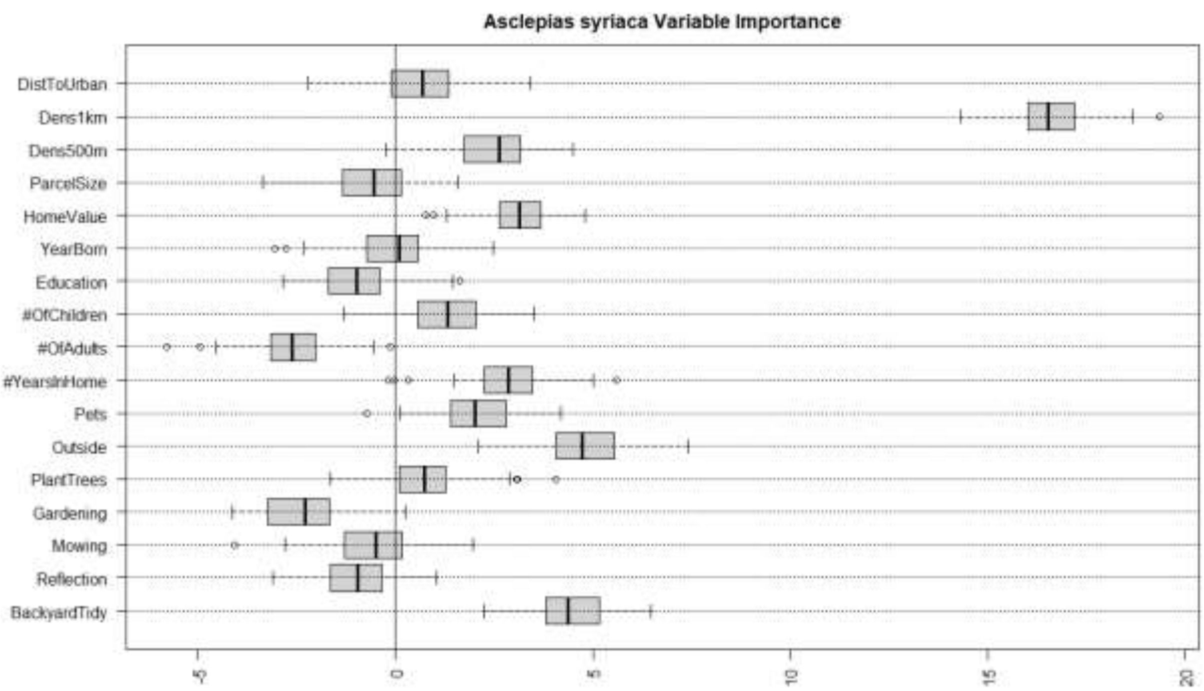
The assessor's market valuation of the property was the only variable positively and non-linearly related to willingness to plant *A. syriaca* (Figure 8). Respondents whose property was valued at $500,000 or less were least willing to plant *A. syriaca* (Figure 8). Willingness to plant *A. syriaca* had a negative non-linear relationship with housing density within a 1 *km* radius of the respondents' property as well as duration of occupancy in the home (Figure 8). A steep decline in willingness to plant *A. syriaca* was exhibited at housing densities greater than 700 dwellings per km^2 (within a 1 *km* radius) (Figure 8). Residents who had lived in their home less than seven years were markedly more willing to plant *A. syriaca* (Figure 8). Respondents who indicated whether or not they have pets that spend time in their backyards were slightly more likely to plant *A. syriaca* than those who stated "No" to having pets that spend time in their backyards (Figure 8). A positive linear relationship exists between willingness to plant *A. syriaca* and residents who stated they enjoy being outside (Figure 8). Finally, willingness to plant *A. syriaca* exhibited a negative linear trend with residents who like to keep their backyards neat and tidy (Figure 8).

Multiple Regression Model to explain Willingness to Plant Asclepias syriaca

A multiple regression model revealed that four variables affected willingness to plant *Asclepias syriaca* ($R^2 = 0.25$, $F(4, 83) = 7.07$ $p < .001$; Figure 5). "I enjoy being outside," and the assessor's valuation of the property, are positively, and significantly correlated to willingness to plant *A. syriaca*. Housing density (1 km^2), and "I like to keep my backyard neat and tidy," are negatively, and significantly correlated to respondents' willingness to plant *A. syriaca* (Table 4). "I enjoy being outside," had the strongest positive coefficient to explain willingness to plant *A. syriaca* followed by "I like to keep my backyard neat and tidy" (Table 4). Housing density (1 km^2) was negatively and significantly correlated with willingness to plant *A. syriaca* (Table 5). County assessor's valuation of the property had a weak, yet positive and significant effect on residents' willingness to plant *A. syriaca* (Table 4).

Figure 7

Boxplot of variable Importance measures explaining Willingness to plant Asclepias syriaca.



Note. Results of 100 random forest runs. Variable names can be found in Table 1.

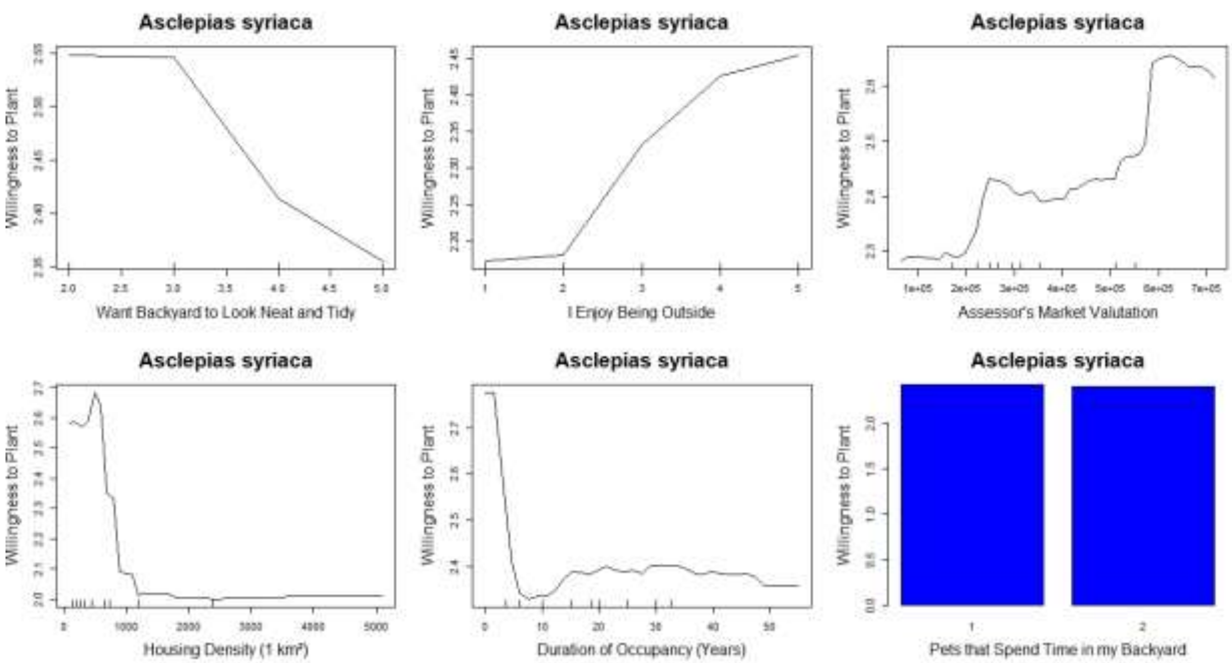
Willingness to Convert Parcel to Pollinator Beneficial Plants

Random Forest Results for Willingness to Convert to Pollinator Plants

Random forest models indicated the following four variables were consistently the most important variables explaining respondents' willingness to convert a portion of their parcel to pollinator beneficial plants: housing density (1 km^2), distance (*ft*) to agglomerations of more than 10,000 people, duration of occupancy (years), and year the respondent was born (Figure 9). Above 2,800 dwellings per km^2 (within a 1 *km* radius), residents were willing to devote more of their parcel to pollinator beneficial plants (Figure 10). Under seven years' duration of occupancy, residents were willing to devote more of their parcel to pollinator beneficial plants (Figure 10).

Figure 8

Partial Dependencies between Willingness to Plant Asclepias syriaca and the most important RHS variables in the random forest models

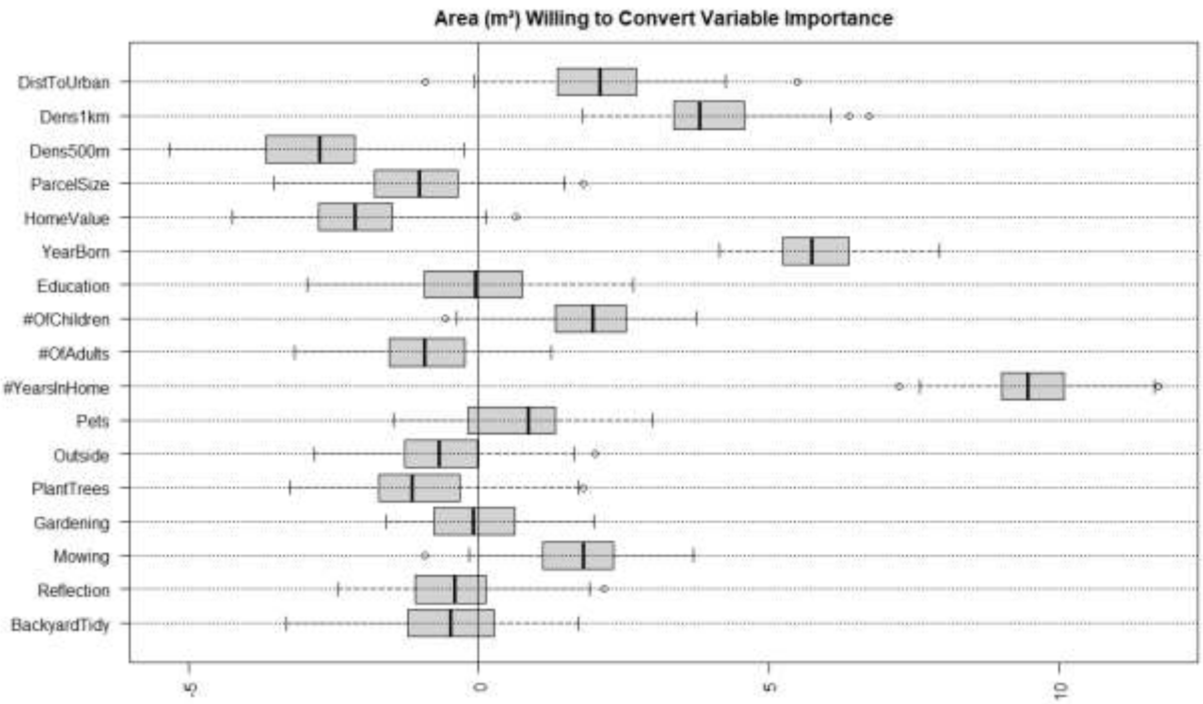


Note. *RHS* = right-hand side variables, Likert scale variables: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly Agree.

Distances (*ft*) to agglomerations of more than 10,000 people had an overall negative and non-linear relationship with converting parcel acreage to pollinator beneficial plants (Figure 10). When residents' properties were more than 18,000 *ft* to an agglomeration of more than 10,000 people, residents were willing to convert less parcel space to pollinator beneficial plants compared to the residents living closer to these agglomerations (Figure 10). Finally, the birth year had a positive non-linear relationship with willingness to convert space to pollinator beneficial plants (Figure 10). Residents born before 1968 were willing to convert less of their yards to pollinator beneficial plants (Figure 10).

Figure 9

Boxplot of Variable Importance Measures for Willingness to Convert to Pollinator Beneficial Plants (all spp.)



Note. Results of 100 random forest runs. Variable names can be found in Table 1.

Multiple Regression Models to Explain the Amount of Land Residents are Willing to Convert to Pollinator Plants

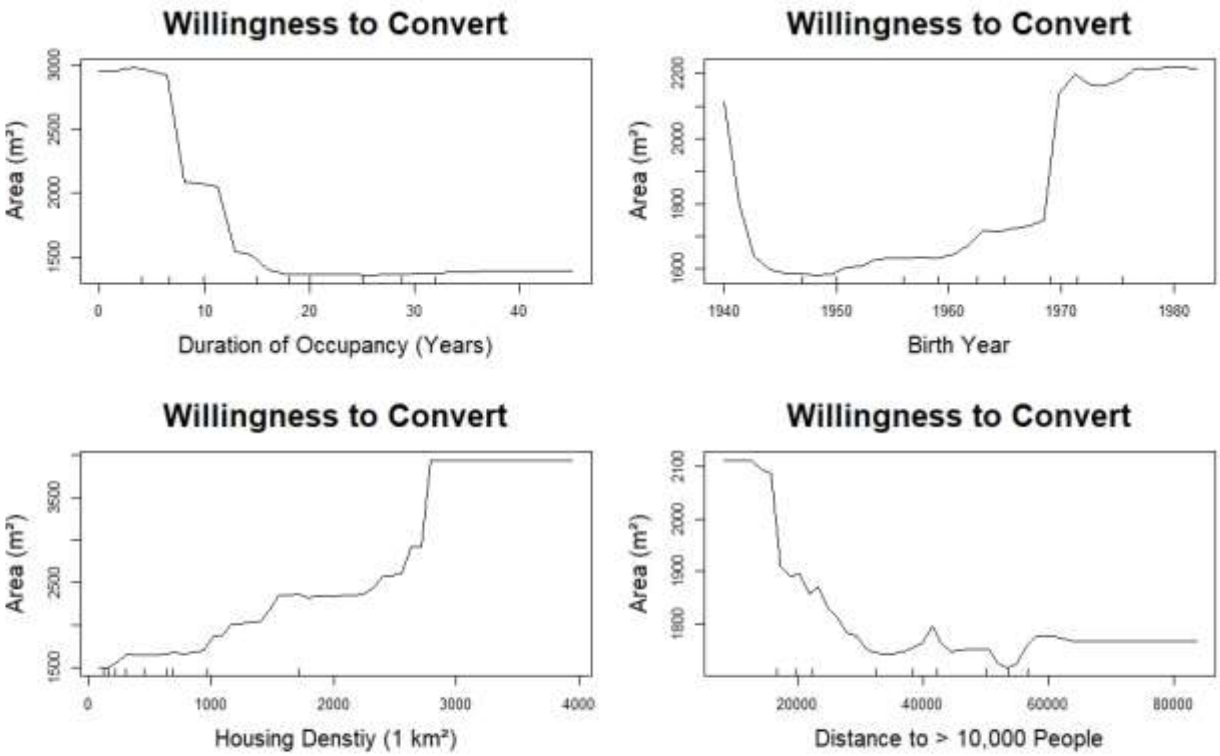
Only the number of years respondents have lived in their homes explained the amount of land respondents were willing to convert to any of the pollinator beneficial plants in the survey (R^2 = 0.12, $F(1, 52) = 6.94$, p = 0.01; Figure 9). The effect is negative, and as respondents live an additional year at their residence, they are willing to convert 0.05 less square meters to these plants (Table 4).

Willingness to Allow White Clover to Grow in Front Yard

Six variables were identified by random forest as important for willingness to allow *T. repens* to grow in their front yards (Figure 11). These include respondents who self-stated they like to keep their backyards neat and tidy, think their yard is a reflection of themselves, and enjoy being outside (Figure 11). Socio-economic importance variables included the county assessor's

Figure 10

Partial Dependencies between Willingness to Convert to Pollinator Beneficial Plants and the most Important RHS Variables in the Random Forest Models.



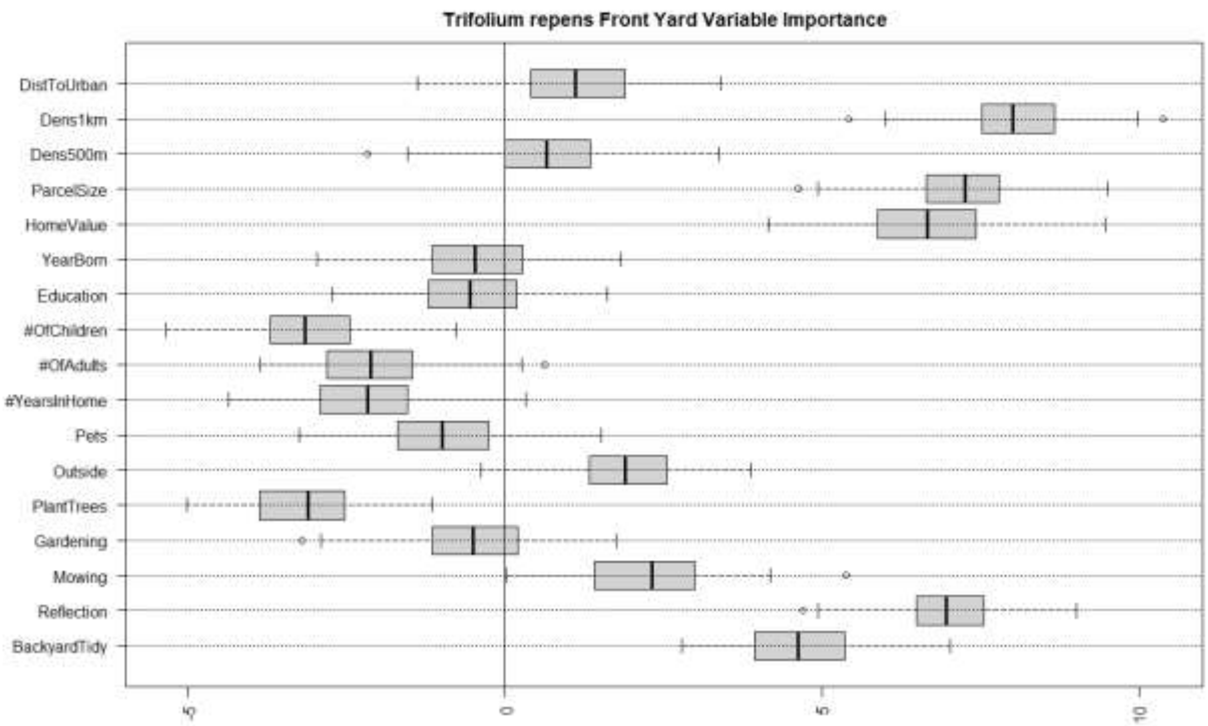
Note. RHS = right-hand side variables. Likert scale variables: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly Agree.

valuation of the property (USD), housing density at 1 km^2 (within a 1 *km* radius), and the total parcel size in (m^2) (Figure 11). Residents who liked to keep their backyards neat and tidy, and think their yard is a reflection of themselves, shared a negative, linear relationship with willingness to allow *T. repens* to grow in their front yards (Figure 12).

Residents who stated they enjoy being outside had a positive, linear relationship with willingness to allow *T. repens* to grow in their front yards (Figure 12). Residents are more willing to allow *T. repens* to grow in their front yards when the county assessor's market valuation of the home is less than $505,000 (Figure 12). When housing densities were below 700 dwelling units per km^2 (within a 1 *km* radius), residents were more willing to allow *T. repens* to grow in their front yards (Figure 12). Finally, residents are more willing to allow *T. repens* to grow on their property at parcel sizes over 10,000 m^2 (approximately 2.5 acres (Figure 12).

Figure 11

Boxplot of Variable Importance Measures for Willingness to Allow Trifolium repens to Grow in Front Yard



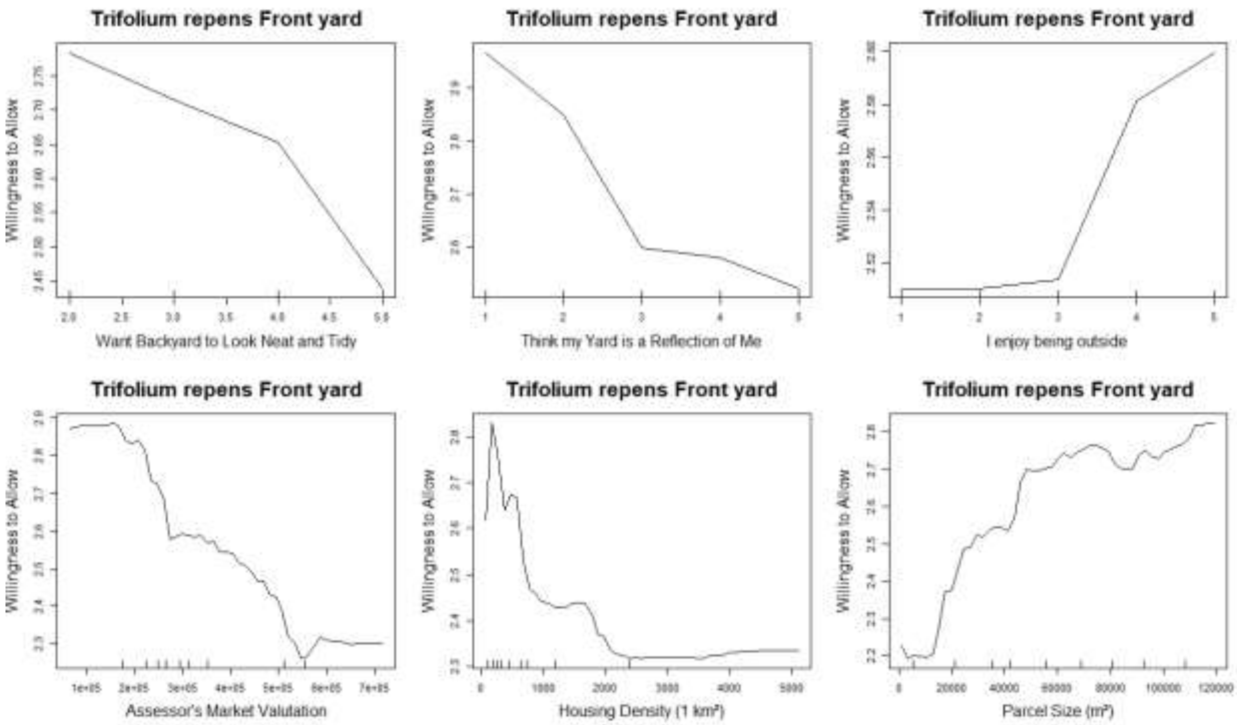
Note. Result of 100 random forest runs. Variable names can be found in Table 1.

Multiple Regression Models to Explain Willingness to Allow Trifolium repens to Grow in Front Yard

RHS variables which best explained willingness to allow *T. repens* to grow in front yards were "I want my backyard to look neat and tidy," housing density (within a 1 km radius), and County assessor's market valuation of the property (USD) (R^2 = 0.25, F(3, 87) = 9.73, p < .001; Figure 11) A significant negative relationship were found between housing density at 1 km^2 (within a 1 *km* radius), and willingness to allow *T. repens* to grow in their front yards as well as it and the County assessor's market valuation of the property (Table 4).

Figure 12

Partial Dependencies between Willingness to Allow Trifolium repens to Grow in Front Yard and the most Important RHS Variables in the Random Forest Models



Note. RHS = right-hand side variables. Likert scale variables: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly Agree.

Willingness to Allow White Clover to Grow in Backyard

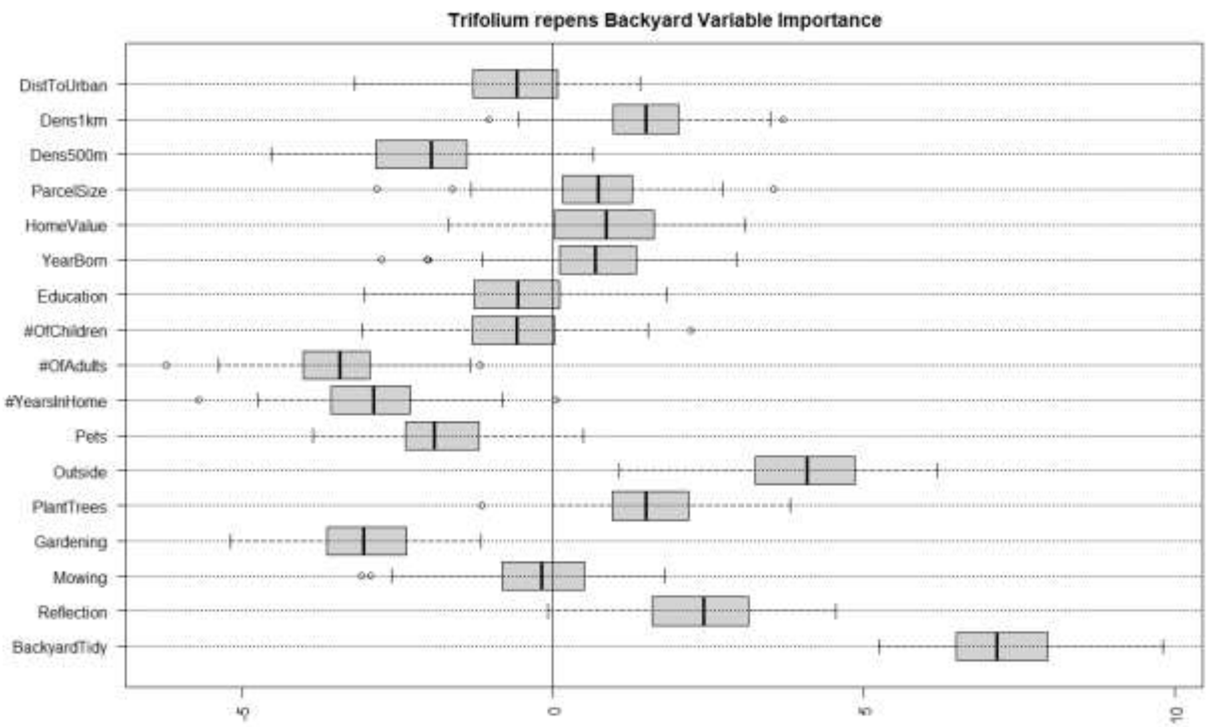
Only two RHS variables were important when it came to willingness to allow *T. repens* to grow in backyards (Figure 13). Residents who like to keep their backyards neat and tidy had a negative, linear relationship with willingness to allow *T. repens* to grow in their backyards (Figure 13). Conversely, residents who enjoy being outside had a positive and significant relationship with willingness to allow *T. repens* to grow in their backyards (Figure 14).

Multiple Regression Models to Explain Willingness to Allow Trifolium repens to grow in backyard

"I want my backyard to look neat and tidy," was negatively, and significantly correlated with residents' willingness to allow *T. repens* to grow in their backyards, and "I enjoy being outside," was positively and significantly correlated with residents' willingness to allow *T. repens* to grow in their backyards (R^2 = 0.18, $F(2, 88)$ = 9.64, p < .001; Table 4).

Figure 13

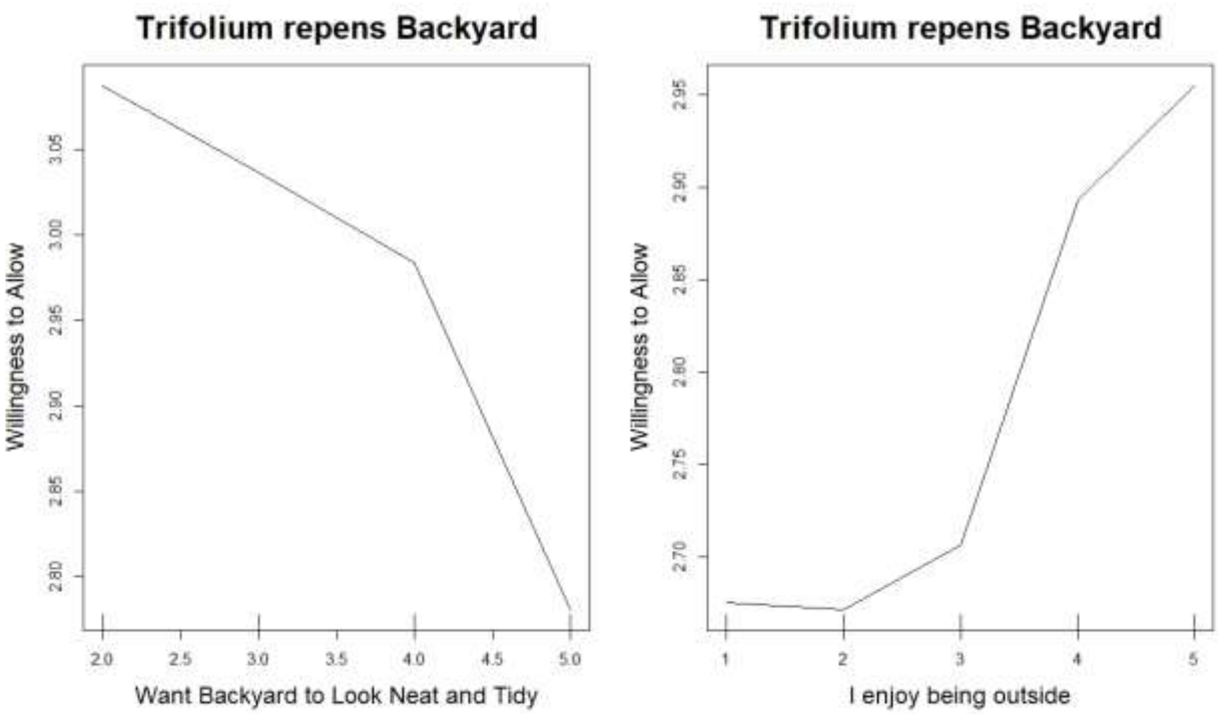
Boxplot of Variable Importance Measures for Willingness to Allow Trifolium repens to Grow in Backyard



Note. Result of 100 random forest runs. Variable names can be found in Table 1.

Figure 14

Partial Dependencies between Willingness to Allow Trifolium repens to Grow in Backyard and the most Important RHS Variables in the Random Forest Models



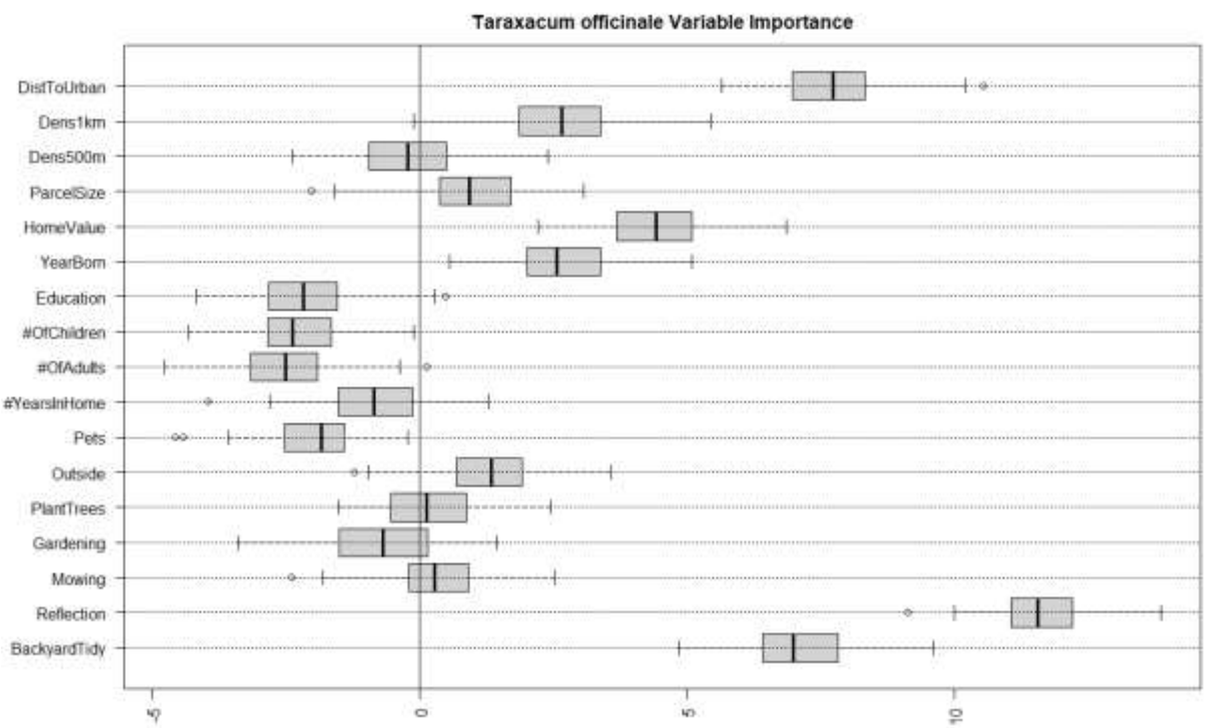
Note. *RHS* = right-hand side variables, Likert scale variables: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly Agree.

Willingness to Allow Dandelion to Grow in Front and Backyard

Five RHS variables were revealed through the random forest models aiming to explain willingness to allow *T. officinale* to grow in front and backyards (Figure 15). Residents who want their backyard to look neat and tidy, think yard is a reflection of themselves, year respondent was born, county assessor's market valuation of the property, and distance to agglomerations of more than 10,000 people (*ft*) were all consistently identified as important in explaining willingness to allow *T. officinale* to grow in front and backyards (Figure 15). Residents who like to keep their backyards neat and tidy, and who see their yards as a reflection of themselves, had a negative, non-linear relationship with willingness to allow *T. officinale* to grow in front and backyards (Figure 16). Residents born before 1980 were less willing to allow *T. officinale* to grow in their front and backyards than residents born after 1980 (Figure 16). Residents living on properties valued less than $400,000 by the county assessor were more willing to allow *T. officinale* to grow in their front and backyards (Figure 16). Finally, residents living 30,000 ft to an agglomeration of more than 10,000 people were less likely to allow *T. officinale* to grow in their front and backyards (Figure 16).

Figure 15

Boxplot of Variable Importance Measures for Willingness to Allow Taraxacum officinal to Grow in Yard



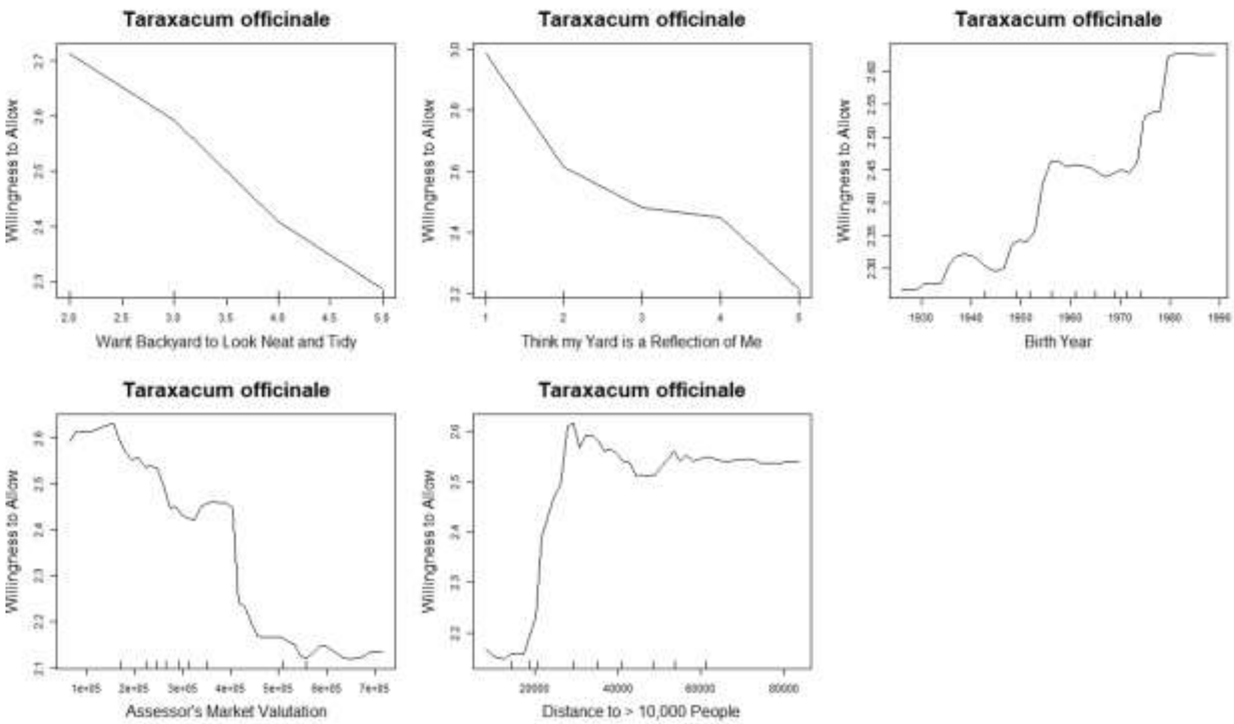
Note. Results of 100 Random Forest Runs. Variable names can be found in Table 1.

Multiple Regression Models to Explain Willingness to Allow Taraxacum officinale to Grow in Front and Backyard

Two of the five RHS variables, "I want my backyard to look neat and tidy," and County assessor's valuation of the property, had a significant effect ($R^2 = 0.18$, $F(2, 86) = 9.65$, $p < .001$; Figure 15) on residents' willingness to allow *T. officinale* to grow in front and backyards. Residents who self-stated they like to keep their backyards neat and tidy were negatively and significantly related to their willingness to allow *T. officinale* (Table 4). County assessor's valuation of the property was negatively, and significantly correlated with residents' willingness to allow *T. officinale* to grow in front and backyards (Table 4).

Figure 16

Partial Dependencies between Willingness to Plant Echinacea purpurea and the most important RHS variables in the Random Forest Models



Note. RHS = right-hand side variables. Likert scale variables: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly Agree.

Discussion

Of the theories that are thought to govern human-environment dynamics in private yard systems, lifestyle variables (Grove et al., 2006) consistently explained willingness to plant all three pollinator beneficial plant species in suburban-rural Ohio. Lifestyle, captured by expenditures on yard upkeep (and thus related to income) (Avolio et al., 2020, Blaine et al., 2013, Grove et al., 2014) as well as variables such as age (Burr et al., 2018; Goddard et al., 2013; Larson et al., 2009, Ramer et al., 2019), importance of social norms (Blaine et al., 2013) and interests in gardening and wildlife (Larson et al., 2008, 2009, 2020; Ramer et al., 2019; Turo & Gardiner, 2018) affects what is planted in gardens. Lifestyle variables that point to the enjoyment of the environment and outdoor activities were also significant in explaining willingness to plant pollinator beneficial plants, but the same variables were not shared among all species shown in the survey. Residents were more willing to plant both wildflowers and *E. purpurea* if they enjoyed planting trees, and more willing to plant *A. syriaca* if they enjoyed being outside. Planting trees could be related to taking pleasure in gardening while enjoying being outside could point more to appreciating nature.

County assessor's valuation of the properties in our population sample were used as a proxy for respondents' income on the grounds that only 62% of respondents reported their 2018 earnings. Reported income and assessor's valuation of the property were highly correlated ($r(68) = .62$, $p < 0.001$). Residents who had more expendable income were more willing to plant the three main pollinator beneficial plants in this study, which corroborates Hopes et al.'s (2003) "luxury effect," in that Pheonix, AZ residents who live on more costly properties are more willing and able to provide increased floral diversity in their yards, and Martin et al.'s (2003) Phoenix study which revealed higher income neighborhoods planted more native plants compared to other income brackets. Similarly, Locke & Grove's (2014) Baltimore, MD study found more tree canopy in higher income neighborhoods, and Avolio et al.'s recent Baltimore study (2020) went a step further and wanted to know whether income or age affected community plant diversity. Tree and plant genera and abundance were revealed in higher income neighborhoods as well as large yards, while age was not consistent with plant diversity (Avolio et al., 2020).

In contrast, for the nonintentional plantings (here, *T. repens* and *T. officinale*) wealthier residents were largely unwilling to allow those plants in their yards. Others have found similar relationships. Indeed, Lowenstein and Minor (2016), uncovered a negative relationship between presence of "weedy plants," and income while profiling flowering plant diversity of 58 neighborhoods in Chicago, IL. Blanchette et al. (2021) found income was positively related to higher species richness of trees, and flowering plants in Salt Lake City, UT, but higher income neighborhoods exhibited less overall lawn species diversity compared to low to median income neighborhoods (Blanchette et al, 2021). It is important to note that in contrast to our study (in suburban and rural parcels), all residents in Blanchette et al. (2021), regardless of income preferred weedless lawns, but only higher income residents could afford the maintenance costs.

Interestingly, we found no relationship between the amount of land residents stated they were willing to convert and property valuation. Instead, the sole predictor of the acreage of new pollinator resources residents would be willing to plant was how recently the respondent had moved into their current home. It could be that over time residents make changes to their yards, modify it so that its appearance and maintenance needs suit them and thus become less flexible with making changes to the yard. This would conform with Verplanken and Roy (2016), who found that people are more open to adopting sustainable lifestyles if they have recently relocated to a new house, especially within the first three months of moving.

Residents who desired a neat and tidy backyard were less willing to plant all of the respective pollinator beneficial plant species as well as allow pollinator beneficial naturalized species to grow, among suburban and rural Ohioans. This finding also seems to support the ecology of prestige theory (Grove et al., 2006, 2014). It is not unexpected as Blaine et al. (2012) found that Ohio survey respondents held aesthetics as the most important aspect of their yard's use, closely followed by a place for socialization, and a place to observe nature and recreate. Indeed, property owners are less willing to plant pollinator beneficial plants if they prefer backyard aesthetics similar to "turf-style lawns," compared to planted yards, or yards with controlled flower beds and exotic species (Visscher et al., 2016).

As population density increased, residents stated they were less willing to convert some of their land to pollinator beneficial plants. Suburban residents may be less accepting of these plants, especially given they do not match the aesthetics of traditional yard plantings (give refs). Residents living in rural communities where parcels tend to be larger may be less influenced by these norms. This idea would confirm studies in which homeowners living on large plots (i.e., greater than 1.3 acres) in Southeastern Michigan, were not as concerned with conformity in terms of yard upkeep than residents of smaller plots (Nassauer et al., 2014; Visscher et al., 2014). In our study, housing density had a positive relationship with stated willingness to convert to pollinator beneficial plants (Figure 7).

The least popular of the three main pollinator beneficial plants in this study was *A. syriaca* which corroborates Davis, et al., (2021), who discovered a similar trend in Butler County, Ohio (South and Southwest of Darke County, and Miami County respectively). Respondents in this study commented about why they would, and would not like to see more of *A. syriaca* planted in their yards and their dislikes ranged from, “Not the most attractive plant,” to just plain, “Ugly,” revealing that yard appearance is high on the list of reasons why they would not like to see it planted. Additionally, some respondents described *A. syriaca* as “invasive” yet it is native to the Eastern United States (Ohio State University, 2021), so perhaps what respondents mean by “invasive,” is the speed at which the plants grow and multiply in these suitable climatic conditions. Residents who like to maintain their yards/gardens for the sake of appearance or ease of care could be deterred from adding such native plants beneficial to pollinators. This is expected as Larson et al.’s (2008) study indicated that Phoenix, AZ residents in median income neighborhoods would much rather spend time maintaining grassy (mesic) lawns than relaxing in low-maintenance, xeric (native) yards with desert plants. Larson et al. (2009) concludes these management behaviors are likely based on neighborhood legacies and personal worldviews. Social norms and attitudes about native plants such as those highlighted by Larson et al. (2008, 2009) may explain a portion of why nearly half of our sample size in Southeastern Ohio would not be willing to convert to native pollinator beneficial plants. We did not quantify plant diversity in this study, however, so it is impossible to make assumptions on the effects of residents’ affinities for native vs. nonnative plants without further research.

Just as Visscher et al. (2014) and Nassauer et al. (2014) found a relationship between larger parcels and more relaxed attitudes about yard appearances in Southeast Michigan, they also discovered a relationship between larger parcels and residents over the age of 45 in the same studies (Visscher et al., 2014; Nassauer et al., 2014). Other factors related to age are biodiversity measures such as Wildlife Resource indices (Goddard et al., 2013). Positive relationships between educated people in higher age brackets, as well as a preference for bird feeding activities at ages 65 and over have also been evidenced (Goddard et al., 2013). However, Ramer et al.'s (2019) study gauging community members’ attitudes about flowering lawns in parks discovered that once community members realized that said flowering lawns would promote bee foraging activities, support decreased as community member age increased. Here, that residents were less likely to allow *T. officinale* to grow in their front yards and backyards as age increased. Older residents likely value a neat and tidy backyard, or care more about social norms.

When residents reach 70 and over, they stated they are less willing to plant wildflowers and *E. purpurea*. Similarly, residents 50 and over, and who have lived on the property for more than seven years tend to be willing to convert less area on their parcel to pollinator beneficial plants. If residents in a higher age bracket still enjoy gardening, they may require low-maintenance options, as evidenced by an interviewee in Larson et al.'s 2009, Phoenix, AZ study, who remarked that he would likely convert his landscape to a native plant that required less maintenance. Residents in St. Louis, MO indicated they are more likely to spray for weeds rather than pulling, as maintenance had begun to become an issue physically (Burr et al., 2018). There is a distinct possibility that some Darke County and Miami County, Ohio residents are unable to keep up with the maintenance involved in starting new gardening ventures, or would rather participate in less strenuous environmental activities. At the time of this survey, the youngest, eldest, and mean age of residents we surveyed would have been 30, 93, and 59 respectively. With the mean age of citizens so close to the age of retirement in the United States (65 years), we cannot help but wonder if the amount of work involved in planting these pollinator beneficial plants is one explanation of lack of willingness to plant pollinator beneficial plants.

Respondents Might be Unsure about Planting Pollinator Beneficial Plants

Many of our respondents did not know whether they would add (or add more) of any pollinator beneficial plants in our study, as "Neither agree nor disagree," was one of the most common answers to that set of questions (Figure 2). It is possible some residents believe they live too close to urban areas to attract pollinator species, or that devoting only a small portion of their yards would be insufficient for pollinators. Burr et al. (2018), identified one St. Louis resident's perception that small front yards are the reason the city is devoid of pollinator beneficial plantings. There is some debate about how much lawn a resident should relinquish in order to have a significant effect on pollinator habitats (Stoyko, 2020). Despite those challenges, academics have managed to locate potential urban areas suitable for pollinators (Derby-Lewis, 2019), and others have managed to quantify pollinator distribution in areas with small plantings and limited space (Sih & Baltus, 1987; Simao et al., 2017; Watson, 2021).

Sih and Baltus (1987) conducted an experiment in Lexington, KY to study plant-pollinator activity where humans reside. Patch sizes (measured as the average number of flowers in a single patch) were observed against the density and abundance of honey bees, bumble bees, and solitary bees (Sih & Baltus, 1987). Honey bee (*Apis*) and bumble bee (*Bombus*) species visited larger patches (400-2000 flowers), but one out of three bees were more likely to visit solitary, or smaller patches (1-400 flowers) (Sih & Baltus, 1987). Recent observational studies have confirmed solitary bees (typically in the *Halictidae* family), actually prefer visitation to areas with smaller plantings. A study from Ann Arbor, Michigan found that over the course of a year, more halictid bee species were observed at "small" plantings compared to other families (Simao et al., 2017). Watson, 2021, confirmed that small and native plantings are beneficial to small bees, and *Bombus spp.* (i.e., large bees) are more likely to be found in urban settings with available food sources. Residents living in more densely populated areas, or who live on smaller parcels might be unaware of the ecological benefits which could arise from devoting a small portion of their parcel to pollinator beneficial plants.

Conclusion

We wanted to know which theory of yard preferences determined the willingness of Darke and Miami County, Ohio residents to plant, allow, or convert land to pollinator beneficial plants. We refer to these theories as l lifestyle, luxury effect, and population density. Population density was consistently an important variable in our random forest models which sought to explain Southwest Ohioans' willingness to plant pollinator beneficial plants on their property. Residents were more willing to plant wildflowers, *E. purpurea,* and *A. syriaca* when densities were less than 950, 800, and 700 $houses/km^2$ (as measured within a 1 *km* radius), respectively. Residents were more willing to allow *T. repens* to grow in their front yards when housing densities were less than 700 dwellings per km^2. To summarize, larger properties, further from "town" were less likely to conform to the pristine turf grass aesthetic that is commonly observed in suburban areas.

Related to Hope et al.'s (2003) "Luxury effect" hypothesis, the county assessor's market valuation of the property was consistently important in our models. Residents who had more expendable income were more willing to plant the three intentionally planted pollinator beneficial plants, but were less willing to allow *T. officinale* to grow in their yards, and *T. repens* to grow in their front yards.

Survey questions related to the "ecology of prestige." (Grove et al., 2006) combined with aesthetic preferences and outdoor activities were consistently the most important variables explaining willingness to plant pollinator beneficial plants in our random forest models. Residents who stated they liked to keep their backyards neat and tidy were less willing to plant the three intentionally planted pollinator beneficial plants in this study (wildflowers, *E purpurea*, and *A. syriaca*), less willing to allow *T. officinale* to grow in their yards, and less willing to allow *T. repens* to grow in front yards and/or backyards. Individuals who enjoy outdoor activities were more willing to plant the three main pollinator beneficial plants, and more willing to allow *T. repens* to grow in their front and backyards.

Lifestyle, as defined by a household's income, age, outdoor activities, preferred yard aesthetics, as well as a neighborhood's population density and social norms, are key to explaining willingness to plant or tolerate multiple pollinator beneficial plants in Southwest Ohio. Please note that housing density and income (or in this case its proxy, i.e. property value) are considered as integral parts to someone's lifestyle.

Marketing strategies to promote pollinator biodiversity on small parcels should dispense information about pollinators that residents might observe visiting small floral patches, and the fact that these patches can make a difference and provide resources for bees. For residents who like to keep their backyards neat and tidy, or enjoy maintaining controlled flowerbeds with exotic species, marketing strategies should also highlight the potential benefits of tending to a small area of pollinator beneficial plants.

Older residents, living on larger parcels that are further away from "town" may be willing to convert a generous portion of their yards to pollinator beneficial plants, but could be unable to handle the physical demands associated with such a project. Local entities interested in promoting pollinator habitat and biodiversity in Darke County and Miami County, Ohio should allocate resources toward assisting older residents with the labor and maintenance aspects involved in establishing pollinator beneficial plants. Residents who have lived in their homes for seven years or less, are wealthier, or keep yards (especially backyards) that could be described as "less manicured," may also be more easily persuaded to convert some of their land to intentionally planted pollinator beneficial plants, such as *E. purpurea*, *Rudbeckia hirta*, and *A. syriaca*.

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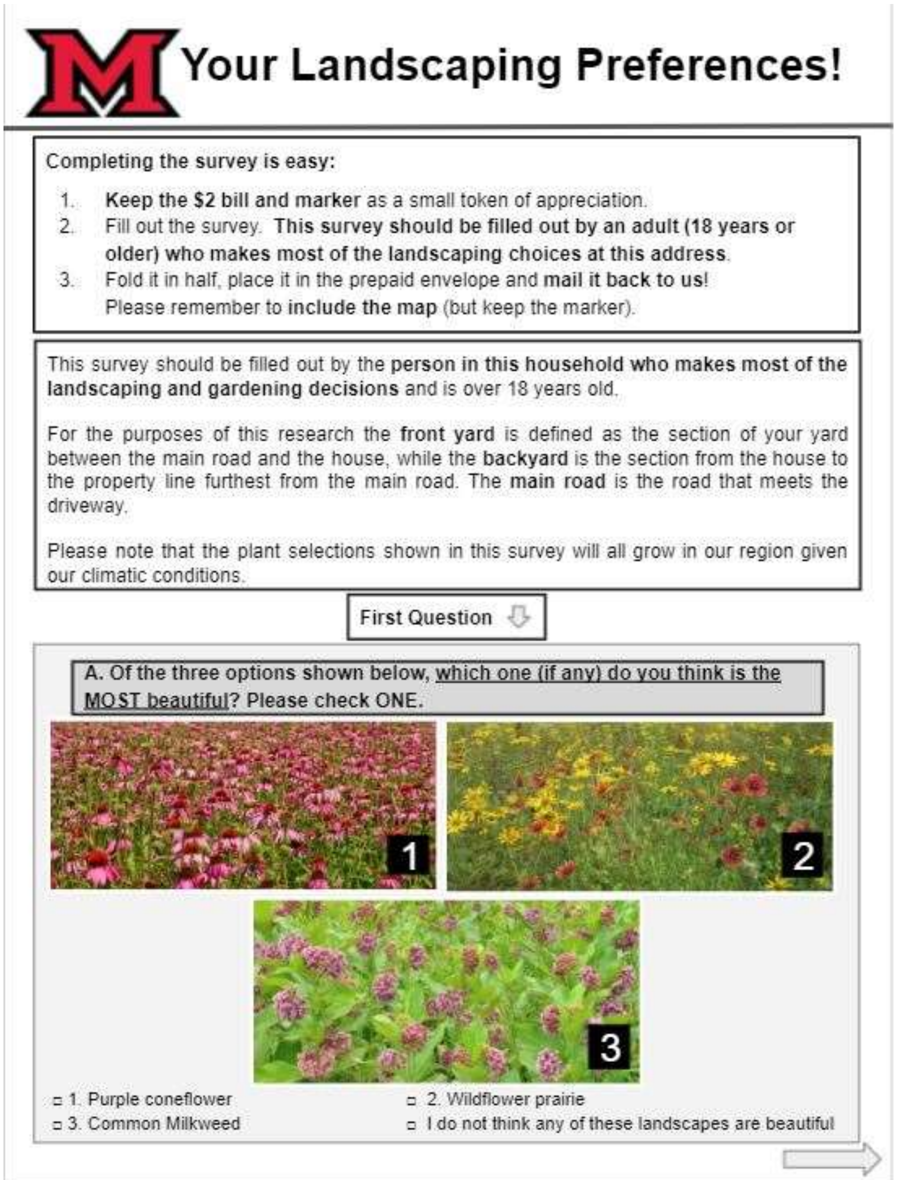
Appendix A

Figure A1

First Page of the Survey Instrument



Your Landscaping Preferences!

Completing the survey is easy:

1. **Keep the $2 bill and marker** as a small token of appreciation.
2. Fill out the survey. **This survey should be filled out by an adult (18 years or older) who makes most of the landscaping choices at this address.**
3. Fold it in half, place it in the prepaid envelope and **mail it back to us!** Please remember to **include the map** (but keep the marker).

This survey should be filled out by the **person in this household who makes most of the landscaping and gardening decisions** and is over 18 years old.

For the purposes of this research the **front yard** is defined as the section of your yard between the main road and the house, while the **backyard** is the section from the house to the property line furthest from the main road. The **main road** is the road that meets the driveway.

Please note that the plant selections shown in this survey will all grow in our region given our climatic conditions.

First Question

A. Of the three options shown below, which one (if any) do you think is the MOST beautiful? Please check ONE.

1 2 3

- ☐ 1. Purple coneflower
- ☐ 2. Wildflower prairie
- ☐ 3. Common Milkweed
- ☐ I do not think any of these landscapes are beautiful

Section A of the survey instrument asks residents if they think any of the pollinator beneficial plants are beautiful (or not).

Appendix A

Figure A2

Page Two of the Survey Instrument

B. These are purple coneflowers (*Echinacea purpurea*)

Bloom: June to August
Height: 2 to 5 feet; Spread: 2 to 5 feet

Do you already have this plant in your yard? Please check ONE.

- ◻ Yes, it was here when I moved in
- ◻ Yes, I planted it here
- ◻ No
- ◻ I don't know

Please write possible reasons you <u>might like</u> to see purple coneflowers in your yard:

____

____

Please write possible reasons you <u>might not like</u> to see purple coneflowers in your yard:

____

____

Please Check the most appropriate box:	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
I know how to plant **coneflowers**	◻	◻	◻	◻	◻
I know how to **care for coneflowers**	◻	◻	◻	◻	◻
I know where to **purchase coneflowers** or its seeds	◻	◻	◻	◻	◻
I will add (or add more) **coneflowers** to my yard **in the next year**	◻	◻	◻	◻	◻
I will add (or add more) **coneflowers** to my yard the **next time I make changes** to my landscape	◻	◻	◻	◻	◻
I would likely add **coneflowers** if I received **help with the cost of seed** for this plant	◻	◻	◻	◻	◻
I would likely add **coneflowers** if I received **online resources** regarding plant purchase, planting, and care	◻	◻	◻	◻	◻
I would likely add **coneflowers** if I received **help with the labor** (i.e. tilling and planting)	◻	◻	◻	◻	◻

Section B: Information, imagery, and questions about residents' knowledge of, and willingness to plant *Echinacea purpurea*.

Appendix A

Figure A3

Page Three of the Survey Instrument

C. These are wildflowers (multiple species of plants)

Bloom time: May to September
Height: varies but usually between 2-4 feet
Multiple plants that bloom at different times so that there is continuous and varied color.

Do you already have wildflowers in your yard?
- ▫ Yes, it was here when I moved in
- ▫ Yes, I planted it here
- ▫ No
- ▫ I don't know

Please write possible reasons you might like to see wildflowers in your yard:

____

____

Please write possible reasons you might not like to see wildflowers in your yard:

____

____

Please Check the most appropriate box:	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
I know how to plant **wildflowers**	▫	▫	▫	▫	▫
I know how to **care for wildflowers**	▫	▫	▫	▫	▫
I know where to **purchase wildflowers** or their seeds	▫	▫	▫	▫	▫
I will add (or add more) **wildflowers** to my yard **in the next year**	▫	▫	▫	▫	▫
I will add (or add more) **wildflowers** to my yard the **next time I make changes** to my landscape	▫	▫	▫	▫	▫
I would likely add **wildflowers** if I received **help with the cost of seed** for these plants	▫	▫	▫	▫	▫
I would likely add **wildflowers** if I received **online resources** regarding plant purchase, planting, and care	▫	▫	▫	▫	▫
I would likely add **wildflowers** if I received **help with the labor** (i.e. tilling and planting)	▫	▫	▫	▫	▫

Section C: Information, imagery, and questions about residents' knowledge of, and willingness to plant Wildflowers (multiple *spp*).

Appendix A

Figure A4

Page Four of the Survey Instrument

D. This is common milkweed (*Asclepias syriaca)*

Bloom Time: June to August
Height: 2.00 to 3.00 feet; Spread: 0.75 to 1.00 feet

Do you already have this plant in your yard?
Please check ONE.
□ Yes, it was here when I moved in
□ Yes, I planted it here
□ No
□ I don't know

Please write possible reasons you might like to see common milkweed (*Asclepias syriaca*) in your yard:
____
____

Please write possible reasons you might not like to see common milkweed (*Asclepias syriaca*) in your yard:
____
____

Please Check the most appropriate box:	Strongly Disagree	Disaree	Neither Agree Nor Disagree	Agree	Strongly Agree
I know how to **plant milkweed**	□	□	□	□	□
I know how to **care for milkweed**	□	□	□	□	□
I know where to **purchase milkweed** or its seeds	□	□	□	□	□
I will add (or add more) **milkweed** to my yard **in the next year**	□	□	□	□	□
I will add (or add more) **milkweed** to my yard the **next time I make changes** to my landscape	□	□	□	□	□
I would likely add **milkweed** if I received **help with the cost of seed** for this plant	□	□	□	□	□
I would likely add **milkweed** if I received **online resources** regarding plant purchase, planting, and care	□	□	□	□	□
I would likely add **milkweed** if I received **help with the labor** (i.e. tilling and planting)	□	□	□	□	□

Section D: Information, imagery, and questions about residents' knowledge of, and willingness to plant *Asclepias syriaca*.

Appendix A

Figure A5

Page Five of the Survey Instrument

E. Map Instructions
Please use the map of this property which was provided in your packet

If you WOULD NOT consider planting any of the plants shown previously in the survey within the next year, please check this box ☐ **and SKIP to section F**

If you WOULD consider planting the plants shown previously WITHIN THE NEXT YEAR, please complete the following 4 steps:

1) **Draw the area or areas where you might plant one of the three plant choices shown in the survey** with the pen we provided on the map we provided.
2) **Label each area** with:
   - **"PC"** if you intend to plant **purple coneflowers**
   - **"CW"** if you intend to plant **common milkweed**
   - **"WP"** if you intend to plant **wildflower prairie**.

If the label will not fit in the area you drew please write the letters next to the area with an arrow pointing to it.

3) **Mark with an X any/all locations where you will plant trees WITHIN THE NEXT YEAR**
4) Please answer the following questions:
   - **Were there any areas that you would consider planting but that were too small to represent on the map.** ☐ Yes ☐ No
   - **The area(s) I drew on the map is/are currently covered in (please check all that apply):** ☐ Pasture ☐ Lawn ☐ Trees ☐ Honeysuckle ☐ Weeds ☐ Crops ☐ Flower beds ☐ Hay ☐ Other (please specify):______________________

F. Your Current Landscaping Practices

Which of the following are present on this property?
☐ Lawn ☐ Pasture/Hay ☐ Trees ☐ Shrubs ☐ Vegetable plot
☐ Hard surface (e.g. driveway, patio, decking, gravel) ☐ Flower beds
☐ Row crops ☐ Other (please state): ______________________

How many trees have you planted since you've lived on this property: _______trees planted

How many trees have you removed since you've lived on this property: ______trees removed

Do you keep bees or let someone keep bees on this property? ☐ Yes ☐ No

In the summer months, how much time do you spend mowing on average each week?
________________hours per week on average in summer spent mowing

Excluding mowing, in the summer months, how much time do you spend gardening, weeding, and/or doing other yard work each week on average?
____________________hours per week on average in summer

Who takes care of your mowing?
☐ Self ☐ Other person living in household ☐ A person (or company) you hire
☐ I/We do not have any lawn ☐ Other ____________________

Who takes care of your landscaping?
☐ Self ☐ Person living in household ☐ A person (or company) you hire
☐ I/We do not have any landscaping needs ☐ Other ____________________

Is your lawn mostly under tree cover, i.e. full shade? ☐ Yes ☐ No

Section E: Mapping instructions for respondents who indicated their intent to plant the pollinator beneficial plants. Section F asked about landscaping practices.

Appendix A

Figure A6

Page Six of the Survey Instrument

Please check the most appropriate box	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I would be willing to **mow my lawn every two weeks** regardless of rainfall	☐	☐	☐	☐	☐
I would be willing to allow **white clover** to grow in my **front yard**	☐	☐	☐	☐	☐
I would be willing to allow **white clover** to grow in my **backyard**	☐	☐	☐	☐	☐
I would be willing to allow **dandelions** to grow in my **front yard**	☐	☐	☐	☐	☐
I would be willing to allow **dandelions** to grow in my **backyard**	☐	☐	☐	☐	☐
I want my **front yard** to look **neat and tidy**	☐	☐	☐	☐	☐
I want my **backyard** to look **neat and tidy**	☐	☐	☐	☐	☐
I **know** how to **plant trees**	☐	☐	☐	☐	☐
I **know** how to **take care of trees**	☐	☐	☐	☐	☐
I think my **yard is a reflection of me**	☐	☐	☐	☐	☐
I enjoy **mowing**	☐	☐	☐	☐	☐
I enjoy **gardening**	☐	☐	☐	☐	☐
I enjoy **planting trees**	☐	☐	☐	☐	☐
I enjoy **caring for trees**	☐	☐	☐	☐	☐
I enjoy being **outside**	☐	☐	☐	☐	☐

Section F (*cont'd*): Survey Questions about Landscaping Practices and other Human-environment interactions.

Appendix A

Figure A7

Page Seven of the Survey Instrument

G. Parcel Characteristics

Do you own a parcel that shares a property line with this property? ◻ Yes ◻ No

Do you own a zero turn radius mower? ◻ Yes ◻ No

Do you have a pond on the property? ◻ Yes ◻ No

Which of the following would you like to see more of on your property (check all that apply)?

◻ Bats ◻ Bees ◻ Beetles ◻ Birds ◻ Butterflies ◻ Deer

◻ Foxes ◻ Moths ◻ Spiders ◻ Squirrels ◻ Other: ____________

Is anyone in your household allergic to bee stings? ◻ Yes ◻ No ◻ I Don't know

Do you have any pets that spend time in your yard? ◻ Yes ◻ No ◻ I Don't know

Do you have white clover in your front yard? ◻ Yes ◻ No ◻ I Don't know

Do you have white clover in your backyard? ◻ Yes ◻ No ◻ I Don't know

Do you have dandelions in your front yard? ◻ Yes ◻ No ◻ I Don't know

Do you have dandelions in your backyard? ◻ Yes ◻ No ◻ I Don't know

In the last year, have you or someone else applied chemicals to control <u>weeds or unwanted plants</u> in the outdoor areas of your home?
◻ Yes ◻ No ◻ I don't know

If yes, to which part(s) of your yard have you or someone else applied chemicals to in order to control weeds or unwanted plants (check all that apply):
◻ Lawn ◻ Flower Beds ◻ Vegetable Garden ◻ Pasture
◻ Other (please specify): ________________________________

In the last year, have you or someone else applied chemicals to control <u>insects or other pests</u> in the outdoor areas of your home?
◻ Yes ◻ No ◻ I don't know

If yes, to what part(s) of your yard have you or someone else applied chemicals in order to control insects or other pests (check all that apply):
◻ Lawn ◻ Flower Beds ◻ Vegetable Garden ◻ Pasture
◻ Other (please specify): ________________________________

In the last year, have you or someone else applied <u>fertilizer</u> on this property?
◻ Yes ◻ No ◻ I don't know

If yes, what part(s) of your yard have you or someone else applied fertilizer to (check all that apply):
◻ Lawn ◻ Flower Beds ◻ Vegetable Garden ◻ Potted Plants
◻ Other (please specify): ________________________________

Is this property a working farm? ◻ Yes ◻ No ◻ I Don't know

Do you keep livestock on this property? ◻ Yes ◻ No ◻ I Don't know

Do you keep horses on this property? ◻ Yes ◻ No ◻ I Don't know

Do you own a tractor? ◻ Yes ◻ No ◻ I Don't know

Do you grow hay on this property? ◻ Yes ◻ No ◻ I Don't know

Last page next!

Section G: Residents are asked an array of questions about how they utilize their yards, and the composition of their yards.

Appendix A

Figure A8

Page Eight of the Survey Instrument

BACKGROUND INFORMATION.
This section is for statistical purposes only.
As a reminder, all survey responses will be strictly confidential.

How many years have you lived in your current home? ______ years

Is some or all the land on this property under a conservation easement? ◻ Yes ◻ No

What year was your house built (approximately)?

◻ <1900 ◻ 1901-1940 ◻ 1941-1960 ◻ 1961-1980 ◻ 1981-2000 ◻ 2001-2010 ◻ 2010-2019

Does your neighborhood have a Homeowners Association? ◻ Yes ◻ No ◻ I don't know

Do you rent or own your home? ◻ Rent ◻ Own

How many people live in your home (including you) that are age 18 or older? _______people

How many people live in your home that are younger than age 18? ___________ people

What is the employment status of the main earner in your household?

◻ Full-time ◻ Part-time ◻ Not working ◻ Retired ◻ Student

What is the highest level of education you have completed?

◻ Less than High School ◻ High School/GED ◻ Certificate Program
◻ Associates Degree ◻ Some College ◻ 4-year College Degree
◻ Graduate Degree ◻ Prefer not to answer

In what year were you born? _________

Are you married or in a domestic partnership? ◻ Yes ◻ No ◻ Prefer not to answer

What is your gender? ◻ Male ◻ Female ◻ Non Binary ◻ Prefer not to answer

How do you identify your race/ethnicity?

◻ White ◻ Hispanic ◻ African American ◻ American Indian
◻ Asian/Pacific Islander ◻ Other ◻ Prefer not to answer

What was your total household income last year, before taxes? Please check ONE answer

◻ Less than $25,000 ◻ $50,001 up to $100,000 ◻ More than $150,001
◻ $25,001 up to $50,000 ◻ $100,001 up to $150,000 ◻ Prefer not to answer

Do you have any final comments you would like to share with us?

____

____

____

If resources mentioned throughout this survey become available, and you would like us to share them with you, please provide your email address: ____________________________

Thank you greatly for completing our survey! Please remember to include the map along with the survey in the prepaid return envelope.

If you misplaced the return envelope we provided to send this survey back to us, please mail it to Dr. Amelie Davis, Dept. of Geography, Miami University, 250 S. Patterson Ave, Oxford OH, 45056.

The final section of the survey asks the resident for demographic information in relation to themselves, their homes, and their neighborhoods.

Appendix B

Table B3

Bartlett's Test for Homogeneity of Variances between Full and Reduced Datasets

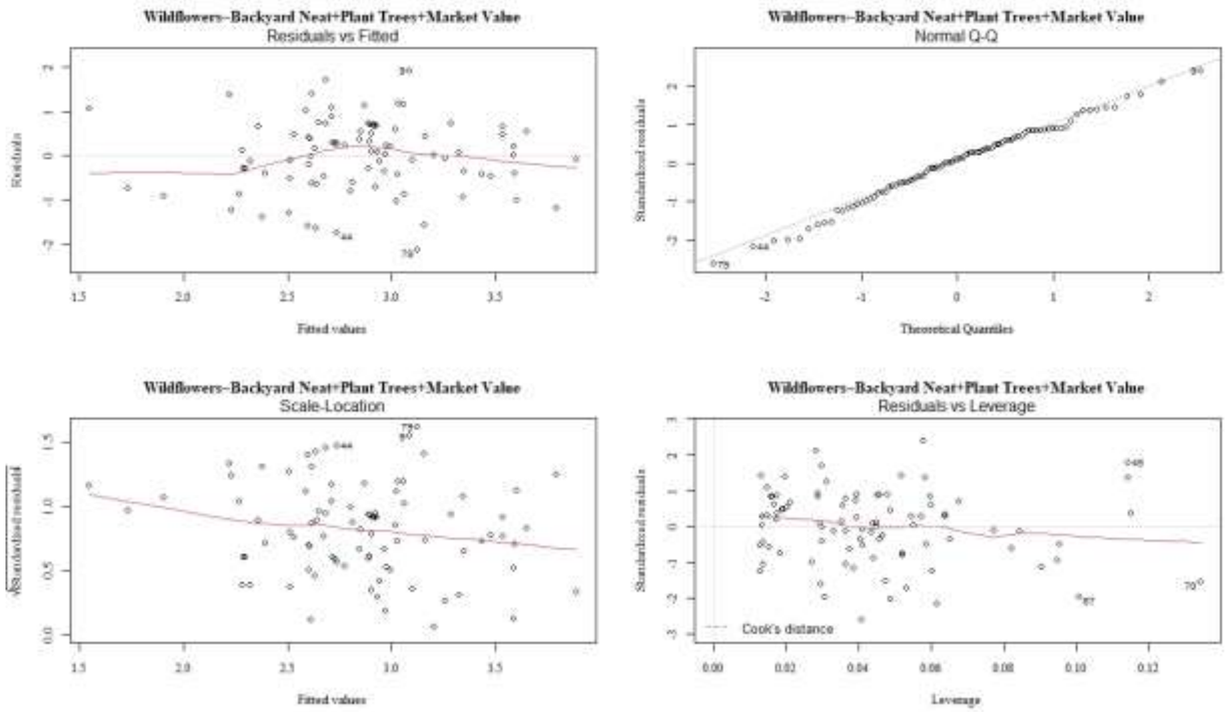
LHS Variable	RHS Variable	*K-squared*	*df*	*p*
Willingness to plant *E. purpurea*	Distance to > 10,000 people (*ft*)	0.025	1	0.87
	I enjoy being outside	0.24	1	0.62
	Housing Density (1 *km²*)	0.031	1	0.86
	I enjoy planting trees	0.17	1	0.68
	I want backyard to look neat and tidy	0.011	1	0.92
	County Assessor's Valuation of the Property	0.086	1	0.77
	In what year were you born?	0.017	1	0.9
Willingness to Plant *A. syriaca*	Housing Density (1 *km²*)	0.0077	1	0.93
	I enjoy being outside	0.3	1	0.59
	How many years have you lived in your current home?	0.057	1	0.81
	I want backyard to look neat and tidy	0.018	1	0.9
	County Assessor's Valuation of the Property	0.2	1	0.65
Willingness to Plant Wildflower *(multiple spp.)*	I want backyard to look neat and tidy	0.011	1	0.92
	I enjoy planting trees	0.16	1	0.69
	I enjoy being outside	0.24	1	0.62
	In what year were you born?	0.01	1	0.92
	County Assessor's Valuation of the Property	0.29	1	0.59
	Distance to > 10,000 people (*ft*)	0.01	1	0.92
	Housing Density (1 *km²*)	0.0002	1	1
Area m² willing to convert	How many years have you lived in your current home?	0.0011	1	0.98
	In what year were you born?	8.19E-05	1	0.99
	Distance to > 10,000 people (*ft*)	0.043	1	0.84
	Housing Density (1 *km²*)	0.9	1	0.34

LHS = left-hand side, RHS = right-hand side. All p-values are greater than 0.05, therefore the null hypothesis cannot be rejected. Full and reduced datasets are homogeneous.

Appendix C

Figure C1

Multiple Regression Models Explaining Residents' Willingness to Plant Wildflowers (multiple spp).

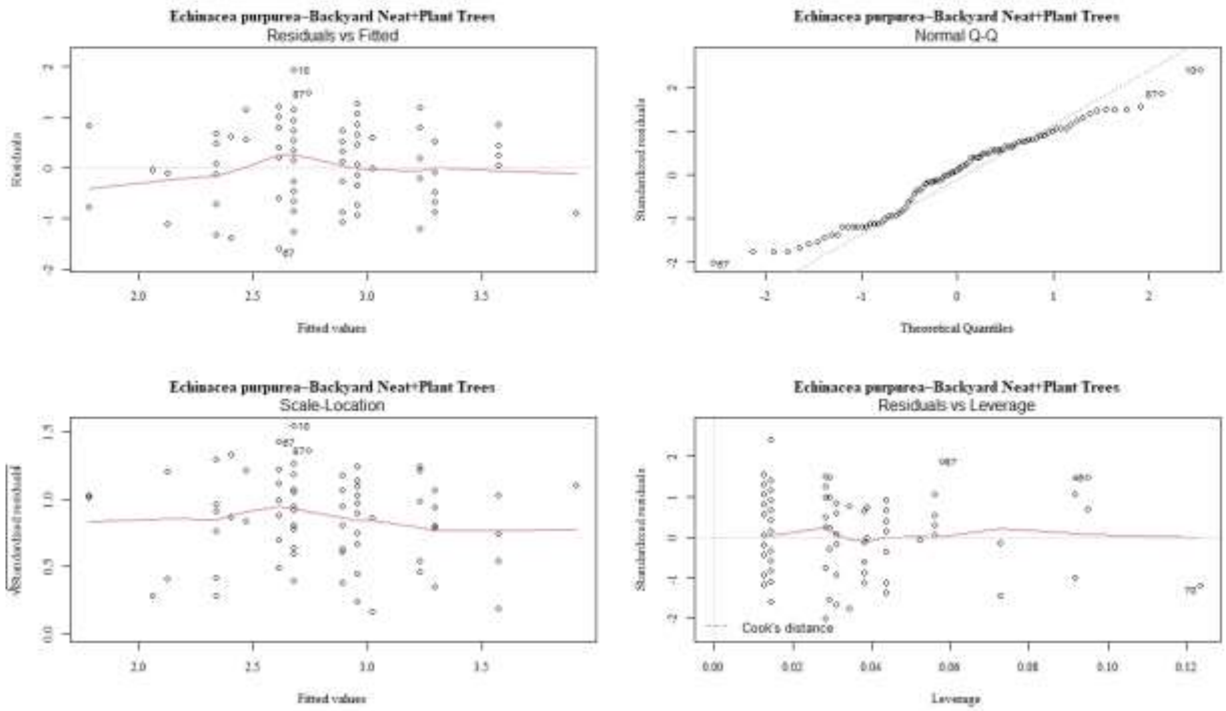


Backyard Neat = "I like to keep my backyard neat and tidy." Plant Trees = "I like to plant trees." Market Value = County Assessor's Market Valuation of the Home. These three variables explain 20% of residents' willingness to plant Wildflowers.

Appendix C

Figure C2

Multiple Regression Models Explaining Residents' Willingness to Plant Echinacea purpurea

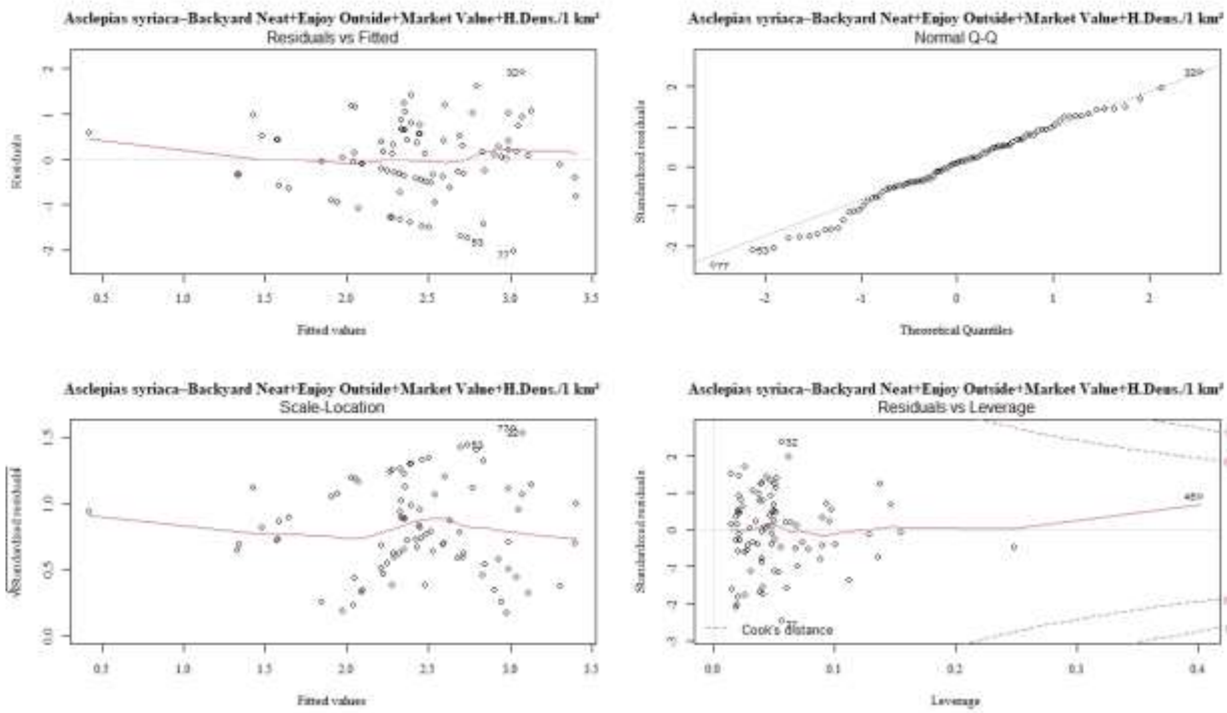


Backyard Neat = "I like to keep my backyard neat and tidy." Plant Trees = "I like to plant Trees." These two variables explain 17% of residents' willingness to plant *Echinacea purpurea*.

Appendix C

Figure C3

Multiple Regression Models Explaining Residents' Willingness to Plant Asclepias syriaca

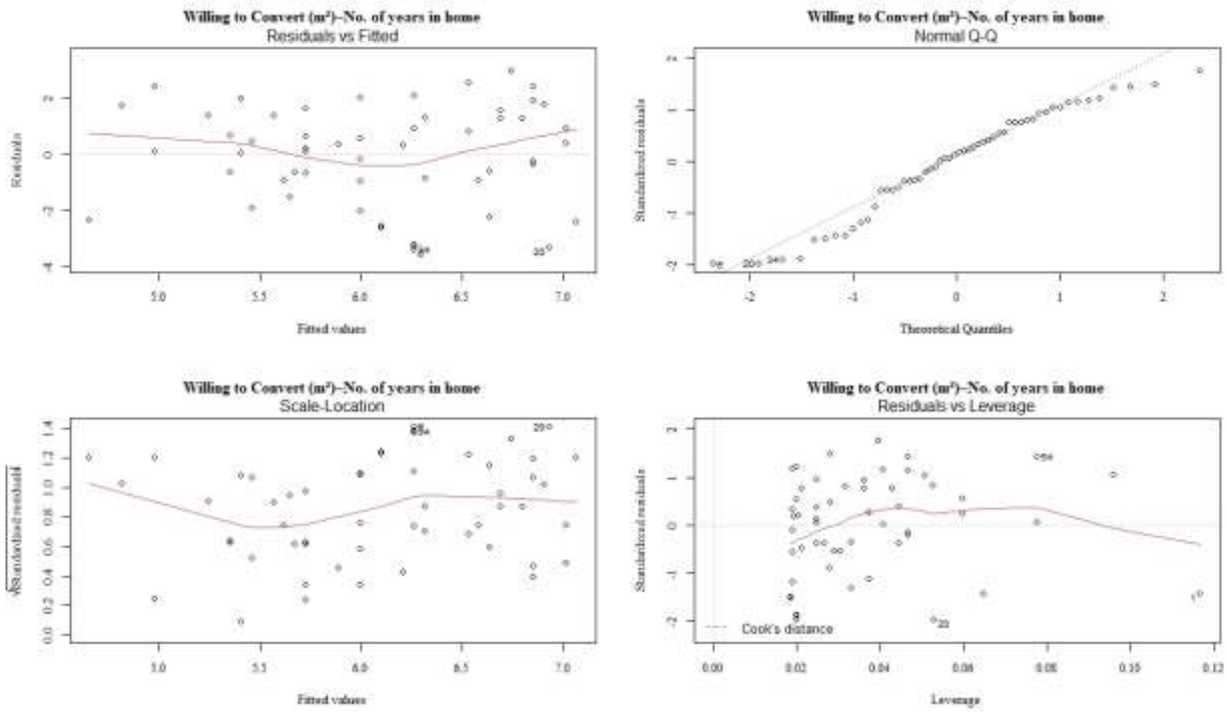


Backyard Neat = "I like to keep my backyard neat and tidy." Enjoy Outside = "I enjoy being outside." Market Value = County Assessor's Market Valuation of the Home. H. Dens./1 km^2 = Housing Density at 1 km squared within a 1 km radius. These four variables explain 25% or residents' willingness to plant *Asclepias syriaca*. Outliers may affect the model.

Appendix C

Figure C4

Multiple Regression Models Explaining Residents' Willingness to Convert a Portion of their Parcel to Pollinator Beneficial Plants

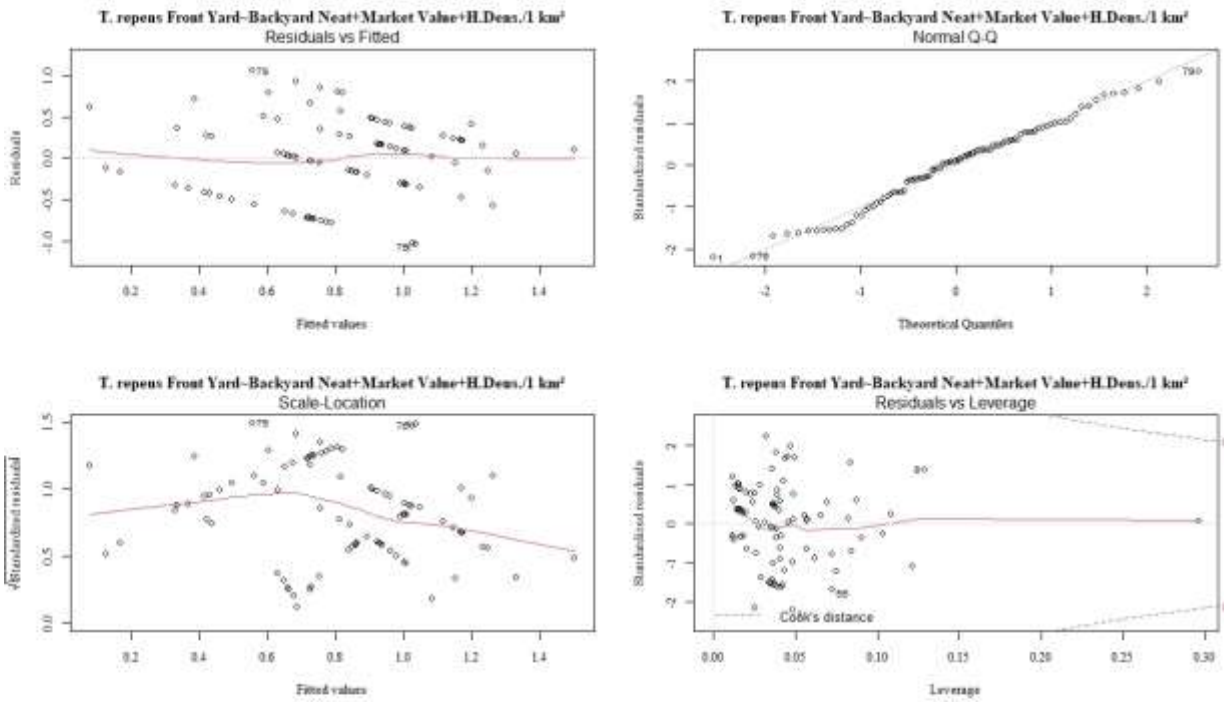


No. of years in home = "How long have you lived in your current home (years)?" This was the sole variable to explain 10% of residents' willingness to convert a portion of their parcel to pollinator beneficial plants.

Appendix C

Figure C5

Multiple Regression Models Explaining Residents' Willingness to Allow Trifolium repens to Grow in their Front Yards

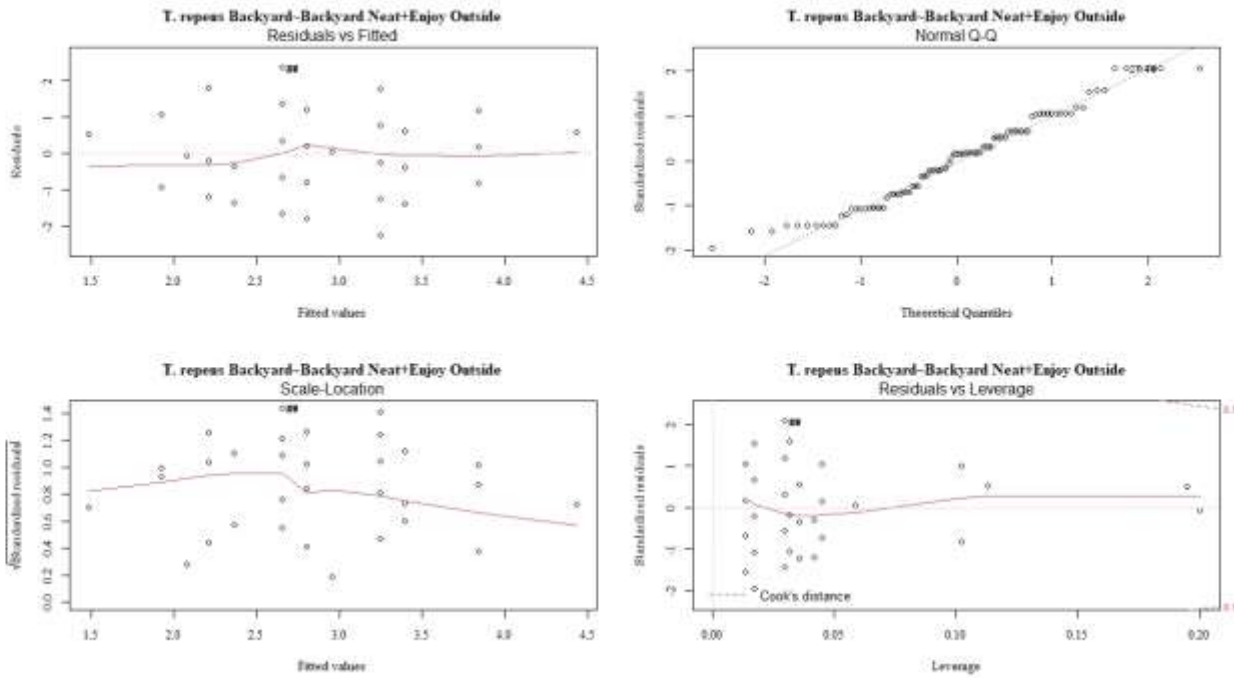


Backyard Neat = "I like to keep my backyard neat and tidy." Market Value = County Assessor's Market Valuation of the Home. H. Dens./1 km² = Housing Density at 1 km within a 1 km radius. These three variables explained 22% of residents' willingness to allow *Trifolium repens* to grow in their front yards.

Appendix C

Appendix C6

Multiple Regression Models Explaining Residents' Willingness to Allow Trifolium Repens to Grow in their Backyards

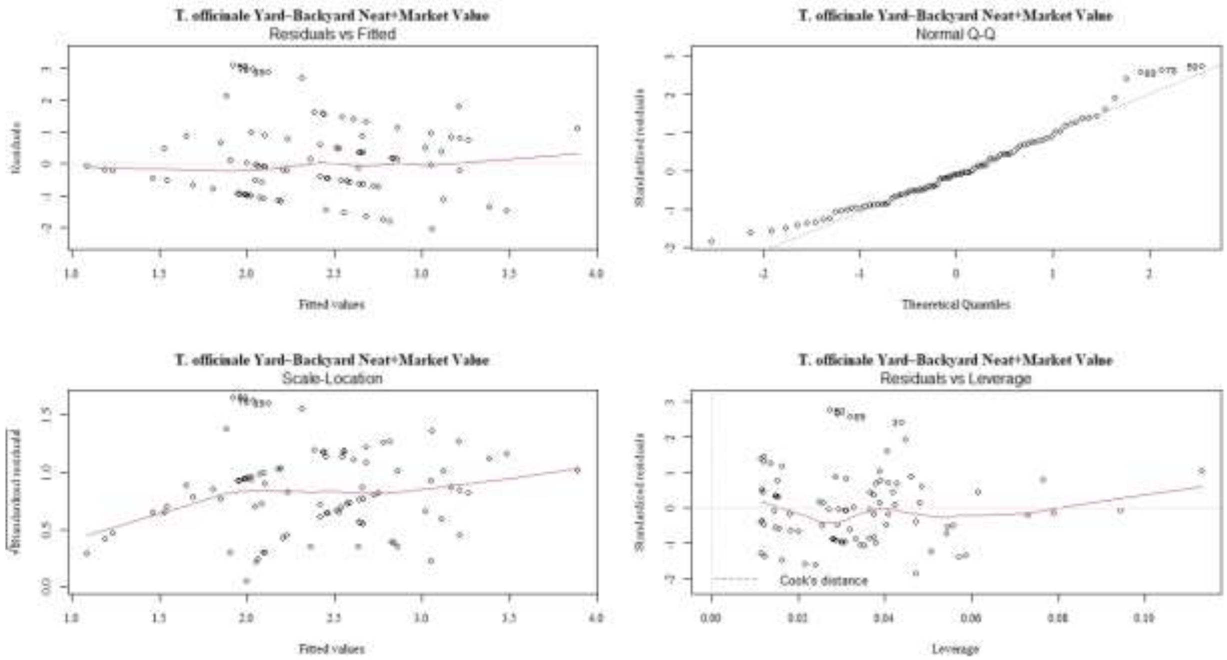


Backyard Neat = "I like to keep my backyard neat and tidy." Enjoy Outside = "I enjoy being outside." These two variables explained 16% of residents' willingness to allow *Trifolium repens* to grow in their backyards.

Appendix C

Figure C7

Multiple Regression Models Explaining Residents' Willingness to Allow Taraxacum officinale to Grow in their Yards (Front Yard and Backyard Combined)



Backyard Neat = "I like to keep my backyard neat and tidy." Market Value = County Assessor's Market Value of the home. These two variables explained 16% of residents' willingness to allow *Taraxacum officinale* to grow in their yards (front and backyards combined).