University of South Florida

Digital Commons @ University of South Florida

November 2017

Perceptions Affecting Tree Valuation: An Analysis of Recently Sold and Leased Properties in Tampa, Florida

Cody R. Winter
University of South Florida, winter1@mail.usf.edu

Perceptions Affecting Tree Valuation: An Analysis of Recently Sold and Leased Properties in

Tampa, Florida

By

Cody R. Winter

A thesis submitted in partial fulfillment
of the requirements for the degree of
Masters Environmental Science & Policy
Department of Geosciences
College of Arts and Sciences
University of South Florida

Co-Major Professor: Graham Tobin, Ph.D.
Co-Major Professor: Shawn Landry, Ph.D.
Rebecca Zarger, Ph.D.

Date of Approval:
November 2, 2017

Keywords: urban forest, tree valuation, perceptions, survey

ACKNOWLEDGMENTS

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

The urban forest is a structure that is fluid in both species composition and how it is integrated in our cities and suburban areas. Much like the fluidity in its structure, the urban forest provides ecosystem services and disservices in many forms. These services and disservices can often come in the form of temperature regulation, lower crime rates, and even higher property values. The latter, which is associated with the economic value of trees, is a part of the hedonic pricing literature which suggests that there is a disparity in the value associated with trees to house prices. With the City of Tampa conducting its own hedonic pricing study, along with the presence of robust urban forest data, 2,000 residents of the city who had recently purchased or rented their home were mailed a questionnaire gauging how trees influenced their decision to live at their current residence and how they perceived the urban forest. Out of the 2,000 properties, 400 of the surveys were received resulting in a 20% return rate.

Five hypotheses were tested to determine how people's perceptions affected the value they place on trees. It was hypothesized that home owners were more likely than renters to report tree disservices due to high maintenance costs, and potential damage. Additionally, it was hypothesized that homeowners would likely report more negative opinions of trees compared to renters. The analysis showed that tree drawbacks related to cost/maintenance and damage were reported by 43% and 45% of homeowners respectively. Likewise, 32% of renters reported cost/maintenance and 37% reported damage as their top drawbacks of trees. Although homeowners more frequently reported cost/maintenance and damage as drawbacks of trees, there was no significant statistical difference in opinion on trees at the .05 level. It was hypothesized that because neighborhood trees

have less drawbacks such as property damage, residents would favor neighborhood trees more than trees on their property. Cross tabulating Likert statements with canopy cover did not reveal a preference for neighborhood trees above trees found directly on resident property. It was hypothesized that respondents living in homes with lower assessed values would express more negative opinions of trees such as cost and maintenance being reported as drawbacks. Cross tabulating sales price with the negative Likert statements concerning trees revealed that homes with higher assessed value reported more negative opinions of trees. It was hypothesized that different ethnic groups such as African Americans, Hispanic/Latinos, and White/Caucasians as well as residents of different affluence would report similar opinions and tree cover percentages with people from similar demographics. Despite the current literature suggesting differences in opinions, preferences, and canopy cover for different races/ethnicities, the analysis did not reveal a link between race/ethnicity and the availability of tree canopy or landscape preference. Finally, it was hypothesized that there would be a high correlation between residents' purchases and/or rental decisions and the extent of canopy cover from trees originating on their property and/or in their neighborhood. For respondents who strongly agreed/agreed that trees influenced their rental/purchase decision there was a marginally higher canopy cover in the area surrounding their property than directly on their property. Additionally, there appeared to be no relationship with the level of agreement that trees influenced residents' decision to rent/purchase and the amount of tree canopy on their property and in their neighborhood.

The conclusions of the study are that the opinions of trees in Tampa, FL are primarily positive among those in the sample population. In order to gain less biased results it is suggested that a door to door method be utilized in the future. It is also suggested that residents' opinions are sampled after a severe storm to assess how hazardous conditions affect the overall opinions surrounding trees.

INTRODUCTION

If you were to ask people what their idea of a forest is, many would likely describe a dense green area covered with trees and other forms of vegetation secluded from the hustle and bustle of human life. While this description more closely aligns with a picturesque forest busy with lush green vegetation that could be found on a postcard, it does not reflect the true diversity of forests. In fact, the reality of forests is that they are complex structures that not only adapt in species composition but also vary in their structure and definition. This complexity in the concept of a forest is partially responsible for the lack of a generally agreed upon definition of a forest (Konijnendijk et al., 2005). An example of this fluidity would be the idea of urban forests, which can be defined as "all publically and privately owned trees within an urban area" (Nowak et al., 2001). Urban forests, in contrast to their "wild" counterparts secluded from the hustle and bustle of human life, can be found in any urbanized area where trees are present and have their own unique history and benefits that it provides to the environment and people.

The use of the term urban forests originated in North America during the 1960's and 1970's and later spread across the Atlantic to Great Britain and the rest of Europe (Konijnendijk et al., 2005). Although the urban forest owes its conceptual beginnings to this period, there is evidence that supports the fact that urban forests have been present in some form across multiple civilizations throughout the centuries. In fact, ancient civilizations utilized trees for aesthetic purposes such as formal gardens, landscapes, and even sacred groves (Koch, 2000). One of the earliest mentions of green space for purposeful use in an urban area was that of the Hanging Gardens in the city of Babylon (Miller, 1997). Beyond this utilization of trees and vegetation in urban environments is the evidence of a stronger relationship between humans and trees in these older ancient civilizations.

1

The Egyptians, Phoenicians, Greeks, and Chinese are some of the civilizations that were believed to have held trees in high regard and in some cases even worshipped them (Grey and Deneke, 1986). Despite the evidence of a deep connection between humans and trees, this love of trees has often changed throughout the centuries, disappearing and reappearing with the changing nature of human establishments. This could be a reason why the historical presence of urban forests stretches back through time farther than its conceptual beginnings in North America.

Erik Jorgensen introduced the concept of urban forestry in 1965 at the University of Toronto, Canada (Jorgensen, 1970). Eventually urban forestry made its way to The United States in 1972 when the Society of American Foresters founded an urban forestry working group (Johnston 1996). The term, much like the previously stated definition provided by Nowak et al. 2001, encompasses all trees around an urban area and not just those that fall within a city's limits. Additionally, management of these areas follows the same ideology where single trees and larger patches found both in the city and just outside of it are treated equally. The definition provided by Jorgensen in his 1965 presentation is as follows:

> "Urban forestry is a specialized branch of forestry and has as its objectives the cultivation
> and management of trees for their present and potential contribution to the physiological,
> sociological and economic well-being of urban society. These contributions include the over-
> all(*sic*) ameliorating effect of trees on their environment, as well as their recreational and
> general amenity value" (Jorgensen, 1986 page 9).

The years following its introduction saw several interpretations of the concept leading to opposition from varying parties (Konijnendijk et al., 2005). Eventually the idea of urban forestry and subsequently the urban forest became integrated into legislation in places such as Ontario, Canada and the United States with several organizations establishing tasks/work forces to oversee its

management (Konijnendijk et al., 2006). An example of this would be the Cooperative Forestry Act of 1978 which launched the US Forest Service's participation with states and local governments in efforts to maintain and manage the urban forest (Konijnendijk et al., 2006). Beyond legislation and the recognition of the urban forest and the practice of urban forestry are the efforts of scientists to better understand the ameliorating effect of trees and their amenity value. In recent years great strides haven been taken by numerous scientists to quantify not only the value of trees but to assess their impact on our environment and society in both positive and negative lights. Research into these topics has occurred all over the globe in places such as the United States, Canada, parts of Europe as well as Australia (Anderson and Cordell, 1988; Conway and Yip, 2016; Jim and Chen, 2009; Peckham et al., 2013; Wang et al., 2015).

It is in this thesis that these studies are given special consideration to better understand their weight and consequence. Specifically, those studies targeting health, social and cultural interactions, and economics are of great importance in determining how the urban forest is perceived and valued by its residents. Due to the ability of the urban forest to provide both benefits and drawbacks to the residents of a city, the perceptions surrounding the urban forest are of particular interest. Additionally, urban forests are increasingly being included in landscape structure planning to ensure an appropriate quality of life for city dwellers (Simson, 2017). With the more frequent inclusion of the urban forest in cities across the globe, many cities such as Tampa, FL are finding that "the inherently close interaction between people and trees in Tampa requires active and diligent management of the urban and community tree and forest resources to ensure public safety" (Northrop et al., 2013). In addition to the efforts of cities to manage their urban forest resources, it is also critical that the relationship between residents of the city and trees is considered and understood in order to allow the urban forest to thrive. This thesis aims to expand the knowledge and understanding of how trees are valued according to their location, differences in how

homeowners and renters view trees, the relationship of sociodemographic factors to people's opinions, and how the presence of trees affects the decision to purchase or rent a home. This thesis addressed these questions by sampling the opinions of residents of the City of Tampa.

LITERATURE REVIEW

The literature concerning the urban forests and its relationship with people can arguably be split up into several categories depending on the scope of the research. This literature review is organized into four categories: Environmental Benefits and Drawbacks, The Relationship between Trees and Health and Safety, The Economic Value of Trees, and The Relationship between Humans and Trees. The Environmental Benefits and Drawbacks will introduce the various contributions that urban forest makes to urban landscapes while outlining the negative qualities of trees in relation to residents. Each benefit and drawback discussed has implications on how trees are perceived and received by residents. The Relationship between Trees and Health and Safety specifically discusses both the negative and positive effects of trees on human health as well as its association with crime rates. The Economic Value of Trees delves into the literature concerning hedonic pricing studies and how trees can both save residents money and increase their property value. The hedonic pricing literature is critical as it provides insight into both the economic value a tree can provide and how trees can be valued based on a variety of factors. Finally, the Relationship between Humans and Trees explores the current knowledge of how residents view trees and how their opinions affect the urban forest. Much of this literature provides the foundation for expectations of how Tampa residents will view the urban forests and what preferences they may have concerning trees.

Scientists have been conducting studies in the past few decades concerning the urban forest and the services/disservices it provides as well as its integration into city planning. Federal, state, and local agencies have not been exempt from this interest in the urban forest and have been implementing policies and laws which better align with the changing values and practices of the people in regards to better management of forest ecosystems (Miller et al., 2015). In fact, all state

governments in the US are actively involved in urban and community forestry programs (Hauer & Johnson, 2008). The participation in these programs is likely connected to both the growing urban population which is expected to reach 75% of the total population by 2050, and the continual growth of mega-cities which places a strain on resources (UN 2012). This results in a growing emphasis on the construction of sustainable urban infrastructure, which include measures for enhanced "provisioning services" such as urban green infrastructure (Tiwary et al., 2017).

With an increasing emphasis on green infrastructure as a necessary part of the urban landscape, it is not surprising that numerous studies have looked at the urban forest's services/disservices as well as its relationship with humans. These ecosystem services are commonly thought of as the benefits people obtain from ecosystems (Millennium Ecosystem Assessment, 2005) while the disservices are the aspects of ecosystems that are perceived as negative for human wellbeing (Lyytimäki & Sipilä, 2009). With respect to the urban forest, ecosystem services often come in the form of aesthetic values, social benefits and temperature regulation while disservices may be related to allergies, threat to safety, health or economy (Wang et al., 2015). Understanding these benefits and drawbacks of the urban forest are critical to determining how the urban forest functions in an urban setting and how the urban population interacts with it. If the urban forest is to be included in cities as a method to combat the negative effects of urbanization, then it is vital that these structures and people's opinions be thoroughly understood.

Environmental Benefits and Drawbacks

Residents of urban areas can gain considerable benefits from urban forests. The environmental benefits, or ecosystem services, that stem from the presence of the urban forest can be categorized into at least three separate categories: temperature regulation, run-off mitigation, and air purification. Temperature regulation is accomplished through the ability of trees to create a more

suitable environment by providing shade, engaging in evapotranspiration, and photosynthesis to keep the surrounding area cooler and more humid (Gomez-Baggethun, 2013; Jim and Chen, 2009). In fact, the presence of trees on the west and south sides of a house can provide enough shade to lower electricity use during the hotter summertime months, saving roughly 185 kWh, or 5.2% of summertime electricity usage, during that time period (Donovan and Butry, 2009). In the same study conducted by Donovan and Butry (2009) estimating the effect of urban trees on summertime electricity usage, they concluded that a tree on the west side of a house could reduce carbon emissions from summertime electricity use by 31% over 100 years. Further studies in California substantiate this claim as it was discovered that trees reduced electric utilities the most on the west and south west sides of a given house for both annual and peak, or summertime, usage (Simpson and McPherson, 1996).

While these benefits are not unique to the urban forest, they have much different consequences for urban populations in comparison to rural forests due to the proximity between the urban forest and people. In terms of temperature regulation, many cities across the globe are plagued by the existence of heat islands. These often represent dense urban areas within cities where the temperature that is recorded is notably higher than neighboring areas or sites located away from the urban center in the suburbs (O'Malley et al., 2015). By scattering green spaces throughout the city, the urban heat island effect can be broken up while providing relief to residents. Regarding urban heat island mitigation, a study conducted by O'Malley et al. (2015) found that utilizing vegetation and implementing green spaces was a feasible strategy for lowering the local air temperature. The study also found that the degree to which the temperature was lowered was dependent on the amount of green spaces and protection of trees. In addition, air purification is achieved through the filtering and fixation of gases and particulate matter through photosynthesis (Nowak et al., 2014).

Air purification impacts urban residents on a more intense scale. By properly placing trees near buildings, the shade provided could result in savings on energy bills each month and lower emissions of pollutants for the city as a whole (Ko et al., 2015). These savings stem from the reduced need to run heating, ventilation, and air conditioning systems units which often draw their energy from unclean sources as well as expel pollutants. In addition to indirectly affecting air pollution by reduced energy usage, trees themselves can remove carbon dioxide and other pollutants through their leaves. On a larger scale, Nowak et al. (2006) suggested that, "urban trees in the conterminous United States remove some 784,000 tons of air pollution annually, with a value of $3.8 billion." This removal of air pollutants doesn't account for carbon dioxide which had an estimated storage of 770 million tons as of 2002 (Nowak and Crane 2002).

Another benefit provided by trees is their impact on local hydrological processes. Run-off mitigation stems from the ability of soil and vegetation to increase water infiltration and the trees ability to prevent rainfall from reaching the ground during times of heavy or prolonged rain and in some cases the trees can prevent erosion in these same storms (Gomez-Baggethun, 2013; Kuehler et al., 2017). Preventing erosion is often accomplished by the binding of soil by tree roots making the soil more difficult to wash away. As more impermeable surfaces are constructed such as roads, sidewalks, and parking lots, there is an increase in run off and the amount of chemicals that mix in with our water. Impermeable surface removes the natural ability of the land to allow water infiltration and creates a reliance on constructed storm water systems. Given the increase of extreme weather events and increased rainfall in many areas, the storm water systems implemented in many urban areas are becoming stressed with updates needed in order to align with drainage needs (Zahmatkesh et al., 2015). Urban forests can reduce the need for these constructed systems. Simultaneously, allowing water to infiltrate through the soil and be absorbed by vegetation can often rid water of harmful chemicals that otherwise may contaminate other parts of the water supply

(Kuehler et al., 2017). Thus, temperature regulation, run-off mitigation, and air purification, are a few of the processes that trees accomplish whether it be a natural forest or the urban forest.

While the urban forest enhances environmental quality and provides a plethora of services to residents, there are also a number of disservices. In urban forests, many species are not recommended for planting because of their potential problems, often related to tree debris, pest vulnerability, and the size of the space they occupy (Kendal, Dobbs, & Lohr, 2014). In addition, trees can have both positive and negative effects, such as shading and soil erosion prevention. While the shade provided by trees helps lower the surrounding temperature, shade can also cut off light needed to support understory plants and vegetation such as lawn grass. Additionally, there are also the concerns of residents as well as municipalities where the roots of trees have cracked the sidewalks and driveways connected to their homes causing uplift and therefore damage to both the property and city infrastructure (Randrup et al., 2001). These problems do not take into account the threat trees pose to the surrounding environment during strong storms, such as hurricanes, that may occur in coastal areas. These storms can bring high powered gusts and sustained winds that uproot even the largest trees such as live oaks and have resulted in both injuries and property damage (Cui and Caracoglia, 2016). Hurricanes are not the only storms that can have this effect, in fact a study was conducted in response to a major ice storm that occurred in Toronto in December of 2013 by Conway and Yip (2013). The study found that to reduce future risks residents removed damaged and even healthy trees in response to the damage they incurred (Conway and Yip, 2013). The weight of the ice and windy conditions produced in the storm led to numerous bent, broken, and downed trees and branches. Initial estimates indicated a 20% loss of canopy across the region, with 40,000 tons of tree debris collected as part of the storm clean-up in the City of Toronto alone (Alamenciak, 2014). The susceptibility of the many urban areas such as the eastern United States to these storm events arguably heightens the cause for concern about potential tree damage.

The urban forest provides a variety of environmental benefits such as run off mitigation and temperature regulation that are critical in densely populated areas. These benefits, provided by the urban forest are not without their disadvantages. Both the benefits and drawbacks of trees are important in understanding how the urban forest is valued by residents. Acknowledging both sides provides opportunities to assess how both the positive and negative aspects of trees relates to the value people place on trees. Assessing both the positive and negative attributes people perceive of trees can provide insight into whether certain benefits outweigh drawbacks.

The Relationship between Trees and Health and Safety

The environmental benefits associated with the urban forest not only directly affects the surrounding environment but also provides human health benefits. For example, Nowak et al. (2014), Donovan et al. (2013), and Donovan et al. (2010) show the urban forest has been associated with a reduction in the frequency of cardiovascular and respiratory cases as well as a reduction in birth and other health risks. Delving further into health research connected to the urban forest, a study conducted by Nowak et al. (2014) concerning the pollution removal due to trees concluded that urban forest impacts and the presence of trees helped prevent 850 mortality cases nationally and roughly 670,000 incidences of acute respiratory symptoms. While the presence of trees has been correlated with lower cardiovascular complications, a study concerning the spread of the Emerald Ash Borer links tree loss with higher complications. The study reported that the loss of tress resulted in higher mortality related to cardiovascular and lower-respiratory problems (Donovan et al. 2013). Additionally, Donovan piloted a study which reported that an increase of 10% in the canopy cover within 50 meters of a home was associated with a lower number of small for gestational age births by 1.42 per 1,000 births compared to the average (Donovan et al. 2010). These results would support the conclusions that the urban forest has benefits related to pregnancy outcomes.

Much like the environmental disservices and services, the presence of the urban forest can serve as a both a curse and a blessing for many people depending on their perceptions. Although these disservices do not necessarily affect the entire population, the presence of pollen and the associated allergies still poses a hardship for allergy prone residents of the area (Dobbs et al., 2014). The pollen generated by certain types of trees such as birch, bayberry, elm, oak, pine and maple can often lead to compromised breathing, excessive mucus production, irritated eyes and skin, as well more serious health concerns. Despite the seasonal nature of this disservice and the variability in terms of amount of pollen produced as well as severity of affliction, it is still a health concern for those with allergies. In regions with a warmer climate, such as Florida, pollen production can occur at most times throughout the year leading to a greater degree of distress than those individuals in cooler environments. It is in warmer regions such as Florida where seasonal allergies and health concerns related to trees become more important.

The previously mentioned studies concerning health as well as environmental services and disservices offer evidence to support both positive and negative perceptions of trees. Considering trees are perceived to both provide benefits as well as inconvenience others, it stands to reason that there should be a similar occurrence in social services and disservices. Social services would be best categorized as services that improve human interactions and foster community well-being while disservices would act in the opposite way. In fact, it was found that exposure to green common spaces is systematically associated with higher levels of social integration and a greater sense of local community (Kweon et al., 1998). This idea is further supported by work undertaken in Calgary and Halifax concerning the importance of values in relation to citizens of a city. The study found that citizens value the urban forests mostly for their non-material benefits, specifically for their social, moral, and intellectual enhancements (Peckham et al., 2013).

One relationship between social conditions and trees that has been explored in detail is the relationship between trees and crime. The work of Kuo and Sullivan (2001) provided evidence that vegetation may promote less crime, and in their study was correlated with lower levels of incivilities. In Baltimore, this relationship was explored through geocoded crime data as well as tree canopy data and concluded that a 10% increase in tree canopy was associated with a 12% decrease in crime (Troy et al., 2012). The study did report however, that in some locations they observed a positive relationship between trees and crime, but the locations were often described as abandoned lands between two different land uses such as industrial and residential. Similarly, a study conducted in Portland, Oregon argued that the relationship between trees and crime was mixed due to view-obstructing trees being associated with increased crime and larger trees being associated with reduced crime (Donovan and Prestemon, 2012). The discussion of the results also explains that there are severe doubts that anyone would increase the number of trees on their property based solely on the ability of trees to reduce crime, but rather would be considered when combined with many other benefits such as the economic gain from trees.

The studies mentioned above offer mixed results due to a gray area between services and disservices which can be associated with different opinions people have of trees. In many of these cases it was found that there was only a modest reduction in crime or that in some cases crime rates could be higher than before trees were introduced to the area. This was mostly attributed to trees blocking the view of the road from the house, allowing criminals to find cover and disguise themselves without being seen. This disservice could also translate to public areas and not just private property. The abundance of trees can serve in the same manner for criminals and in fact make public parks and tree lined streets more dangerous for residents at night.

The health and safety related studies discussed above provide a look into the benefits and disservices that are more relevant to the day to day lives of residents. While temperature regulation or stormwater run-off mitigation are things many people may be unaware of, crime rates and health related effects are likely more pressing concerns to people living in proximity to the urban forest. These studies detail a closer relationship between trees and people and suggest that trees have a much greater effect on the day to day life of some. Hence, it would seem important, in this respect, that health and safety related services and disservices of trees are included to gauge resident perception of the value of urban trees.

The Economic Value of Trees

The economic benefits of the urban forest in relation to residential properties directly impact both the property owners and renters and are arguably some of the most tangible benefits of the urban forest. The work undertaken by Donovan and Butry (2010; 2011) provides support for the economic benefits of trees to homeowners through higher property values but that trees provide drawbacks to renters through higher monthly rent values. The tangibility of economic services is so apparent in some cases that renters have a possible disincentive to plant trees to keep their monthly rent lower (Perkins et al., 2004). The ability of property owners to make decisions concerning the vegetation and trees on their land results in major structural implications for the urban forest. The ability of property owners and renters to create or influence property level growth or loss to the urban forest makes the economic benefits a critical aspect in the health and prominence of the urban forest.

Due to the structural implications of economic services of the urban forest an understanding of how trees are valued economically by residents of the area is essential. Numerous studies have been conducted to determine the average value a tree or street tree can add to a single property (Des

Rosiers et al. 2006, Payton et al. 2008, and Siriwardena et al. 2016). One of the earliest examples of the economic value of trees comes from research conducted in Athens, Georgia in 1988. This study concluded that mid and large sized trees, regardless of species, increased average sales price between $2869 and $3073 (Anderson and Cordell, 1988). In Portland, Oregon and Perth, Western Australia, hedonic pricing studies were conducted and both reported additions to the price of a home of $13,000 USD and $8,870 USD respectively (Pandit et al., 2013; Donovan and Butry, 2010). In addition to the study conducted in Portland, Donovan and Butry (2011), completed similar work in the same area targeting the value of trees on the rental price of homes. The study found that a tree on the lot of a house increased the monthly rent by $5.62 and a tree in the right of way resulted in an increase of $21.00. Similarly, studies in Grand Rapids, Michigan and Research Triangle, North Carolina found that homes bordering a forest preserve increased the value 19% to 35% and increasing forest cover by 10% on a parcel increased the value by $800 (Thorsnes, 2002; Mansfield et al., 2005). The hedonic property price models utilized in many of these tree valuation studies can estimate the value of urban trees based on property characteristics and sale prices or assessed values of properties (Sander et al., 2010). Usually these pricing models include dummy attributes that allow for the measurement of tree cover as well as other characteristics of the vegetation cover in the surrounding area. While the vegetation in different regions may vary in composition and structure, the disparity in the value of trees to the prices of homes reveals there may be other attributes that affect the difference in the value of trees in different parts of the world.

The common conclusion that these studies share is that trees do add value to both rental and sales price of a home. What the research also shows is that there is a disparity between the value residents place on street trees versus those found directly on residents' properties. Donovan and Butry (2011) highlighted this in their work assessing the effect of urban trees on rental price. Evidence of this difference was further backed by a hedonic pricing study in Perth, Western

Australia which not only found a difference in value between location of tree but as also with the species of tree (Pandit et al., 2013). Both studies attributed this difference in value to people may view the disamenities associated with trees such as maintenance, costs, and damage to pavement that fall under a property owner's responsibility. Specifically, Donovan and Butry (2011) found that the value of a tree is larger for neighboring properties than it is for the house where it is located. He suggests that when considering maintenance costs, homeowners would underinvest in trees on their own property and instead reap the benefit of trees that others have to maintain.

The hedonic pricing literature, as well as related studies that have examined the value people place on trees, sets a precedence for determining the value of environmental services and how trees are valued in specific areas. The disparity between these values as seen between Portland, Oregon and Perth, Australia highlights the possible relationship between resident opinions about trees and the economic value they assign to trees. This is corroborated by Des Rosier et al. (2006) who attributed this heterogeneity to differences in landscape preferences of individuals. Understanding the research of various locations is pertinent in determining what factors are expected to affect the value of trees in a certain area. Specifically, the economic value studies relating to air conditioning systems and the disparity in value between trees on residents' property and neighborhood trees provide information as to what residents might value and which trees might be valued more highly in Tampa.

The Relationship between Humans and Trees

Research into the effect of residents' opinions on the value of trees is an important foundation for the ideas and goals of this thesis. At State College in Pennsylvania, US, 676 residents were surveyed and it was found that residents valued street trees more based on their location compared to trees on properties (Gorman, 2004). An important aspect of Gorman's findings were

that special care be taken not to directly transfer the results to other locations, that opinions of trees were possibly derivative of residents of that specific environment. In Alabama, it was shown that support for urban tree programs and a willingness to donate to these projects were associated with people who knew of these programs, held a full-time job, were younger than 56 years old, and made above $75,000 USD (Zhang et al., 2007). Although this study suggests a willingness to support these programs among certain demographics, research conducted in Southern Appalachia noted that many Americans may view tree protection less favorably if there is a possibility of devaluation to their property (Jones et al., 2012). Further investigation into the relationship between humans and trees reveals that in New York, residents who were surveyed about who should be responsible for tree stewardship and maintenance of public trees reported that it should fall to the government, rather than the residents themselves or to multiple non-profit organizations (Moskell and Allred, 2013).

Other researchers suggest there may also be differences in opinions related to socio-demographic characteristics on trees found on resident property and neighborhood trees as well. Des Rosier et al. (2007) attributed the heterogeneity of hedonic pricing studies to differences in landscape preferences of residents. In the United Kingdom, it was found that climate, size of property, and street layout were associated with the heterogeneity of attitudes toward street trees (Schroeder et al., 2006). Additionally, Fraser and Kenney (2000) reported that cultural background and landscape traditions can have an influence on landscape preference of the individual. Fraser and Kenney specifically targeted British, Chinese, Italian, and Portuguese communities in different Canadian cities, to which they found the British reacted more positively to shade trees than any other community (2006). Hitchmough and Bonugli (1997) focused their research on the combined opinions of one town's residents towards street trees. Unlike the aforementioned studies, Hitchmough and Bonugli found that support for the planting of trees in the streets they studied is generally low, and particularly so among the streets with the least affluent residents.

This is further backed by a study in Melbourne, Australia which found that areas where ecosystem services are scarcely available coincided with areas that were regarded as being more socially vulnerable, which the study identified as poorer and less educated (Dobbs et al., 2014). In contrast, education status (percentage of university degree holders) was a positive predictor of backyard and street trees/shrubs (Pham et al., 2013). The heterogeneity in availability of the urban forest can also be seen in Milwaukee, Wisconsin where a study concluded that non-Hispanic White populations were correlated with more canopy cover and Hispanic populations with less (Heynen et al., 2006). Additionally, a 2009 study of the city of Tampa revealed that there was evidence of racial inequality in the distribution of tree cover in Old Tampa, specifically among the African American population (Landry and Chakraborty, 2009). Based on the literature it would seem that greater canopy cover is associated with more affluent communities. If lower affluence and more socially vulnerable communities are correlated with less canopy cover, then it is possible sociodemographic background can have a direct influence on the planting, maintenance, and opinions of the urban forest and trees on the property level. Also, it would seem that affluence often coincides with both the abundance of the urban forests as well as the reception and perception of its benefits. The affluence of residents and the abundance of the urban forest resource is a relationship that will be explored in this thesis to determine if this coincidence persists in Tampa.

The hedonic pricing literature shows that households often pay a premium for homes located in neighborhoods with greener, denser vegetation (Payton et al., 2008). These premiums are often directed towards greenery that does not fall in their property. Non-hedonic pricing studies such as Troy et al. (2012), found that there was a strong inverse association between crime rates and tree canopy cover. While Donovan and Butry (2009) concluded that trees located on the west and south side of properties can reduce summertime energy consumption. These studies suggest a willingness to pay for greener areas as well as a relationship between increased canopy cover and

ecosystem services. These studies can be combined with the work of Fraser and Kenney (2006) concerning the influence of cultural background on landscape preferences. The willingness to pay for greener areas may be connected to the idea that landscape preferences might be related to sociodemographic factors as well as level of affluence. Additionally, affluence may lead wealthier families to move to neighborhoods with more perceived amenities such as vegetation on both public and private lands (Chowdhury et al., 2011). This could mean that premiums and ecosystem services dependent on a certain type of cover are better received under certain conditions such as income, ethnicity, and canopy cover. The correlation, or lack thereof, between certain ecosystem services such as crime reduction and energy savings, and canopy cover, ethnicity, and income is a relationship that will be further explored in this thesis.

The increased integration of the urban forest into city planning suggests that there will be an increase in human-tree interactions as time passes. It is clear that the inclusion of trees in our urban areas serve the people beneficially through ecosystem services while simultaneously having a negative effect on certain populations in these urban areas. While the ecosystem services and disservices of the urban forest have been widely studied and understood, much of the literature suggests a disparity in how these services/disservices are valued and perceived. It is also noted in the current literature, that although many studies have investigated how resident opinions affect the urban forest it is important to understand that each region may hold different values towards trees and how it affects how they are perceived. The benefits that trees and urban forests provide to cities across the globe could be maximized while the drawbacks could possibly be minimized with a better understanding of the perceptions' affecting the value of trees and how residents perceive and receive trees. Studying this relationship could have a positive effect on the quantity of trees as well as their quality resulting in a healthier and larger urban forest.

This thesis seeks to better explore how the urban forest is related to people's opinions of trees and perceptions of their value by surveying resident opinions of trees in Tampa, FL. The goal of this thesis is to more accurately explain the consequences resident opinions have on the presence and value of the urban forest and, in turn, provide data that can be utilized to better plan for the inclusion and management of the urban forest in cities across the globe.

Research Questions and Hypotheses

Several hypotheses were derived from the literature.

1. It is hypothesized that home owners are more likely than renters to report tree disservices due to high maintenance costs, and potential damage. Additionally, it is hypothesized that homeowners will likely report more negative opinions of trees compared to renters.

The conclusions from the literature suggests that some residents might value neighborhood trees more than trees growing on their property. The work of Donovan and Butry (2011) found that homeowners bear 100% of the cost for their trees while not receiving 100% of the benefit. They suggest that the disparity between cost and benefit, if recognized by residents, could lead to a disincentive to invest in trees by homeowners. Randrup et al. (2001) cited the roots systems of trees causing damage to both foundations and sidewalks as a concern of homeowners as well as municipalities. The damage incurred by homes from tree debris as a result of an ice storm has also shown that the drawbacks related to trees can negatively affect their availability on private property (Conway and Yip, 2013). Additionally, Gorman (2004) stated that residents valued street trees more based on their location compared to trees on properties. The literature provides some support for the idea that neighborhood trees are valued more by certain residents, such as homeowners, than trees directly on properties, but is there evidence to support a difference in preference for

neighborhood trees rather than property trees by residents in Tampa, Florida? Specifically, do property owners have strong negative opinions about tree-related maintenance? Are there differences in opinions related to maintenance between owners and renters?

It is expected that the responses by homeowners regarding tree disservices will feature maintenance and costs as the top drawbacks associated with trees. Furthermore, renters are expected to have more positive opinions on trees compared to property owners. Support for this would manifests itself as a higher positive correlation between rented properties and opinions of trees when compared to property owners and opinions of trees. These opinions could include: renters agreeing with both statements about wanting to live in a neighborhood with large trees and agreeing with statements about having trees on their lot, renters reporting that trees have benefits they want in their neighborhood, or the lack of cost, maintenance or damage as a reported drawback of trees by renters.

2. It is hypothesized that because neighborhood trees have fewer drawbacks such as property damage, residents will favor neighborhood trees more than trees on their property.

It is expected that Tampa residents will report the same trend of neighborhood trees being favored more than trees on residents' property as found in the literature. Evidence for this would be found in more residents reporting that they prefer their neighborhood to have more trees than their own property. Additionally, resident who favor neighborhood trees more might have a high percent of canopy cover in the surrounding area rather than directly on their property.

3. It is hypothesized that respondents living in homes with lower assessed values will express more negative opinions of trees such as cost and maintenance being reported as drawbacks.

The literature suggests that home owners in lower valued housing perceive greater problems associated with trees than owners in higher valued property. Similarly, higher valued property often experiences a greater exposure to the urban forest resource in comparison to lower valued properties.

Hitchmough and Bonugli (1997) found that support for the planting of trees in the streets they studied is generally low, and particularly so among the streets with the least affluent residents. In contrast, education status (percentage of university degree holders) was a positive predictor of backyard and street trees/shrubs in Montreal (Pham et al., 2013). Additionally, it was suggested that affluence may lead wealthier families to move to neighborhoods with more perceived amenities such as vegetation on both public and private lands (Chowdhury et al., 2011). The literature points to a possible relationship between higher affluence and higher rates of vegetation as well as a higher availability of ecosystem services. Similarly, it would appears that areas of lower affluence experience the opposite effect. Given the current literature, is there a link between level of affluence and more negative opinion of trees?

It is expected that lower valued homes will correlate with more negative opinions of trees than houses with higher value. Evidence to support this would be residents of lower value properties expressing more drawbacks of trees than residents of properties with higher values. A negative correlation between parcel value and agreement with statements reflecting tree drawbacks, or a positive correlation with statements reflecting tree benefits would also exist.

4. It is hypothesized that resident opinions about trees will differ between racial/ethnic groups such as African Americans, Hispanic/Latinos, and White/Caucasians. It is also hypothesized that tree cover percentages at resident properties will be different between racial/ethnic groups.

Landscape preference has been cited by Des Rosier et al. (2007) as one of the possible explanations to the varying values trees add to the sales price of homes. Additionally, Fraser and Kenney (2006) have reported that ethnicity can also have an effect on landscape preferences specifically that those of British decent were more likely to prefer mature shade trees while those of Chinese decent preferred small ornamental gardens. Hitmough and Bonugli found that support for planting trees is often low among streets with less affluent residents (1997). It was also found in Melbourne, Australia, that low provision of ecosystem services coincided with areas that are considered more socially vulnerable (Dobbs et al., 2014). Considering Tampa, and Florida, is home to people who represent a diversity of ethnic groups and socioeconomic status, does ethnicity and affluence affect how trees are perceived and valued in Tampa? Is there an association between less affluent residents, ethnicity, canopy cover, and opinions about trees?

It is expected that landscape condition and number of trees will correlate with ethnicity and how positive or negative their opinions of trees. Evidence in Milwaukee that shows African American resident's view fence-line, or neighborhood trees, as a nuisance due to a lack of maintenance (Heynen et al., 2006). Socially vulnerable areas also tend to experience a lower provision of ecosystem services from properly managed trees (Dobbs et al., 2014). It is believed that residents who have landscapes which are well maintained and have trees on the lot will have more positive opinions of trees than those residents who have properties that have well maintained lawns but no trees. Additionally, these relationships will also correlate with ethnicity. Support for these hypotheses would exist through a positive correlation between a given ethnicity (such as African Americans, Hispanic/Latinos, and White/Caucasians), the number of trees/landscape maintenance, and positive responses to the survey. Similarly, evidence could be found in negative responses to survey questions and a low number of trees/poor landscape maintenance.

5. It is hypothesized that there will be a high correlation between residents' purchases and/or rental decisions and the extent of canopy cover from trees originating on their property and/or in their neighborhood.

Heynen at el. (2006) reported an uneven distribution in tree canopy which specifically favored areas with more affluent, white residents rather than the less affluent areas and Hispanic/African American residents. In Tampa, FL, well-intentioned tree planting and management practices utilized in a low-income and largely African American neighborhood resulted in an equitable outcome due to the hardship posed by tree maintenance for newly planted trees (Landry and Chakraborty, 2009). The idea of the 'luxury effect' posit that households with more disposable income will purchase more of everything, including greater expenditures on yard care and yard care services (Locke et al., 2016). Locke et al. also suggests that the distribution of canopy is related to the idea that people will change their land management decisions to fit in or gain acceptance from neighbors. Due to the wide range of benefits people often associated with trees and the tendency of people to buy/own things to gain acceptance from neighbors or for luxury, is there a correlation between purchase/rental decision and the presence of trees on residents' property and in their neighborhood?

It is expected that a high positive correlation will exist between canopy cover and the influence of trees on purchase decisions. Similarly, it is expected that this correlation will be higher between purchase decisions and the percent of canopy cover within a certain distance of the property. This is because the literature supports the fact that neighborhood trees are more highly valued than trees found on residents' property. Evidence to support this hypothesis would be a higher positive correlation between neighborhood canopy cover and purchase decision as well as a

high positive correlation between the Likert statement and canopy cover on the respondent's property.

STUDY AREA

Understanding the factors that limit the value of trees is highly dependent on understanding the region in which the valuation studies are being conducted. In order to examine some of contextual factors influence tree value, a study was conducted in the City of Tampa, Florida, United States. Tampa is located at 28°N and 82°W at roughly the midpoint of the state (Landry et al. 2013). It is home to 369,075 residents as of 2015 and covers an area of 179 square miles (City of Tampa: Demographics 2015).

The population of Tampa has a 51% female to 49% male split with 63% of all residents being Caucasian, 26% African American, 23% Hispanic or Latino, 3% Asian, and 7% reporting a mixed background or other (City of Tampa: Demographics 2015). The city has conducted an urban forest analysis every 5 years beginning in 2006 in conjunction with the city's urban forest management plan (Northrop et al. 2013; Landry et al., 2014). In the 2011 analysis, the study found that the land comprised 32% tree canopy and 32% other vegetation, while the remaining land was largely impervious material (Landry et al. 2013). The existence of these previous studies in Tampa provides a baseline for possible trends, structure, and status of the urban forest which will be important to understand how these structures are perceived.

METHODS

The availability of preexisting urban forest data was a large factor in the selection of Tampa as a study site. While the City of Tampa is already the subject of a number of studies concerning its urban forest, there are few data that examines the relationship between residents' opinions of trees and their relationships with tree valuation. Understanding these relationships requires a more detailed look into how people view the urban forest and whether or not they are even aware of the services and disservices it provides. To accomplish this, several steps were taken to ensure this examination into ecosystem services/disservices and resident's perception was effective and efficient.

This study focused on residents of recently purchased single family homes located within the City of Tampa. Recently sold single family homes were the subject of study for several reasons. First, in contrast to multi-family properties, the landscape of single-family homes are more directly under the control of the resident. Second, single-family homes total 157,130 residential properties in Tampa (City of Tampa: Demographics 2015). Additionally, residents of recently sold/rented properties were expected to have a greater memory of the factors that influenced their decision to purchase/rent their property. Finally, single family homes were selected to correlate with a concurrent hedonic pricing study (Pers. Communication with Shawn Landry). Location, address and characteristics of single family properties was acquired from property data that was downloaded from the Hillsborough County (FL) Property Appraisers Office on June 2, 2016 (HCPA 2016). Attribute data included with each parcel was used to select the sample population. The Florida Department of Revenue (DOR) land use code of 0100 was used to identify "detached single family homes." Single-family parcels were selected that sold during the time period from May 2015 to May

2016; these included 4,848 properties (HCPA 2016). From this dataset, 2,000 properties were randomly selected and utilized as a sample population, with 2,000 being the maximum number of surveys the budget could support. These properties were then narrowed down to the May 2015 to May 2016 time period based on the notion that residents could more effectively communicate those factors that went into their purchase decisions compared to residents who had lived at their current residence for many years. The site address provided in the appraisal dataset, which indicated the physical address of a house, was utilized to capture information from both owners and renters. The sample area is shown in Figure 1. These residents were then mailed a questionnaire to better understand their relationship with trees and how they affected their decision to purchase or lease their home.

Figure 1: Study Area and Sample Population
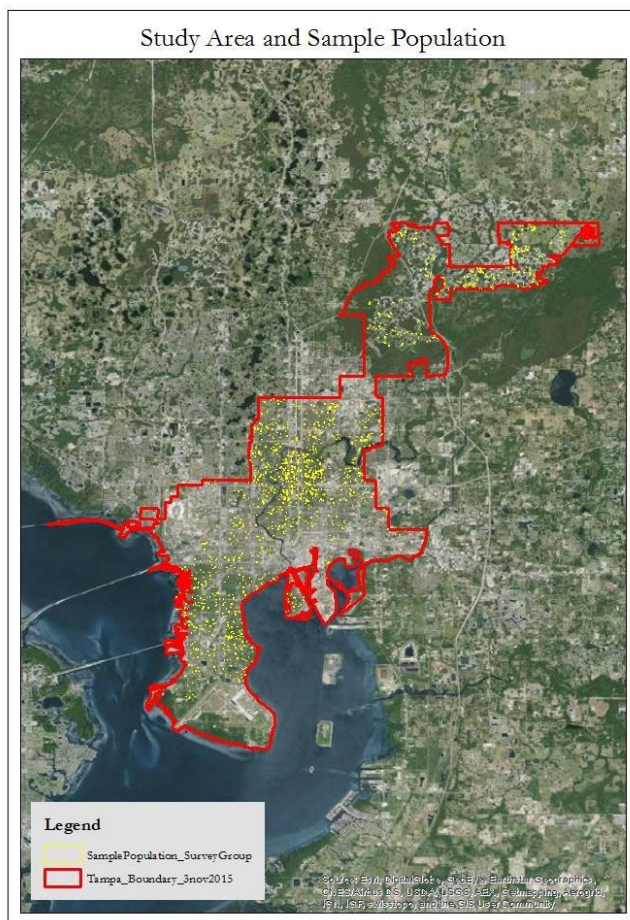
The ability of the sample population to effectively communicate the factors that effected their purchase/renting decision and their relationship with trees was critical in the overall analysis in this study. A mailed questionnaire to the sample of recently sold single-family homes was determined to be the best tool that would allow participants to communicate their thoughts in

a structured but independent manner. The survey, which was given IRB approval, # <u>00027783,</u> (IRB

protects the rights, safety, and welfare of human subjects who participate in the research programs

of the USF system) accomplished this by providing the participant the opportunity to answer a

mixture of multiple choice, free response, and Likert scale questions. The decision to incorporate

these types of questions stems from previous surveys conducted which concerned the urban forest

such as Conway and Yip (2013). The questionnaire survey was split into six parts: Tree benefits and

drawbacks, Opinions about trees in your neighborhood, Tree/Outdoor experience, Property history,

Property information, and Demographic information. The full survey can be found in Appendix A.

The questionnaire built on those questions utilized in similar studies, particularly those

pertaining to the Likert statements. Additionally, several questions were asked to identify specific

trends among the sample population. The tree benefits and drawbacks section asked respondents to

identify their top two to three benefits and drawbacks they associate with trees. In the opinions

about trees in your neighborhood section, respondents were given 21 statements concerning

different aspects of trees and were asked to rate how strongly they agreed or disagreed with each

statement. Tree/Outdoor experience asked several questions about how long respondents spent

time outside and how/where they spent that time. The property history section asked residents to

identify how many trees they had in their front yard, whether they had planted or removed a tree

since their purchase, and if their home had sustained damaged as a result of severe weather.

Property information asked respondents to provide their street address. Finally, the demographic

information section asked respondents to identify what gender they associate themselves with, what

bracket their age fell under, if they had any children, and with race/ethnicities they identified with.

Asking questions about how long and frequently respondents spent time outside as well as where

they spent that time was expected to reveal how people were interacting with trees. This

information could have implications for urban forest policy and what aspects of the urban forest the

City of Tampa should focus on. The survey was mailed in two waves. The first mailing was sent on December 9th, 2016 and the second, a follow-up reminder to those not previously responding, was sent on January 23rd, 2017. The surveys were returned after completion in a self-addressed postage-paid business reply envelope. While the surveys were being sent out to the sample population, the properties included in the study were analyzed for house condition, landscape condition, number of trees, and the tree type (broadleaf, coniferous, and palm) utilizing google street view. This information was collected to determine landscape preferences and to see if there was a correlation with ethnicity or property value. House and landscape conditions were assessed on a 1 to 3 scale with 1 being poor, 2 being average, and 3 being above average. These levels were taken from a concurrent hedonic pricing study that also assessed landscape and house characteristics. The landscape condition was assessed based on whether or not it appeared the lawn to be green, well-trimmed, and free of clutter. The house condition was dependent on the appearance of the roof tile (whether they were missing or decayed), if the paint was unchipped and unstained, and the condition of the windows and doors.

Survey responses were digitized upon collection and entered into a Microsoft Access database file. Once the responses had been digitized and correctly formatted, they were linked to a GIS map featuring the geographic and appraisal information of the sample population. The responses were linked based on the site address of the property parcel as specified in the map and reported by survey respondents. The resulting join between the access file and sample population layer allowed the survey response and property information to be assessed simultaneously.

To explore the research questions identified through gaps in the literature and accurately test the resulting hypotheses, several steps were taken beyond compiling the survey results. A new variable was created to determine if a property was rented or not based on whether the site address matched the owner address in the original parcel data. If the site address and owner address were

matching, then that response was coded as N, meaning the owner lived in the home and therefore it was not a rental. Similarly, the properties which provided an address also had their appraisal value added into their record as a property value variable. The addition of these two attributes allow for a in-depth analysis into a respondents socio-demographic background.

With the completion of the survey, spatial analysis of the respondent properties was completed in ArcGIS. This portion of the analysis involved creating a polygon layer that captured the tree canopy from trees falling within the property's boundaries. This was accomplished by drawing circles around trees which fell within the boundaries and then tracing the circles and property boundary to create a new polygon, as shown in Figure 2. This new layer, called CanopyCollection, was then joined with the sample population layer. After the canopy collection had been completed for each respondent who gave an address, the area of canopy was tabulated for each of the new polygons within the CanopyCollection layer utilizing land cover data. The land cover data was taken from the 2016 City of Tampa Urban Forest Analysis (Landry et al., in-press). These variables and their source are outlined in Table 1. Utilizing the tabulate area tool in ArcGIS, the land cover data was tabulated for amount of tree canopy within the property boundary. This value was then divided by the total area within the property boundary to find the percent of canopy within each property boundary. The tabulated areas were joined back to the sample population layer to keep all the necessary property information together. In addition to the tabulated area for the CanopyCollection layer, a buffer of 200 meters was also created to capture canopy cover for the surrounding neighborhood of each property. This buffer was based on previous studies which utilized distance as a factor in their urban forest research. (See for example, Donovan and Prestemon (2010) which used a 200 meter buffer to assess crime, and Troy et al. (2012), who employed a buffer of 500 meters in their study. While some studies utilized smaller buffers such as 30m to 100 m and others expanded their area past 500 meters, 200 meters was chosen as a middle

ground which could account for larger neighborhood attributes but still close enough to be influential to the residents on that property. This was done to determine if responses to neighborhood questions correlated with more or less tree canopy cover in the respondent's neighborhood. After the buffer had been created for each property utilizing the buffer tool in ArcGIS, the area within the buffer was tabulated for the amount of canopy cover within each area.

Table 1: Variable Descriptions and Sources

Variable	Description	Source
Number of Trees	Number of palm, broadleaf, and conifer trees on a properties front yard.	Visually determined using Google Streetview
Landscape Condition	Scale assessment of a property's landscape with 1 being poor, 2 being average, and 3 being above average.	Visually determined using Google Streetview
House Condition	Scale assessment of a property's house with 1 being poor, 2 being average, and 3 being above average.	Visually determined using Google Streetview
Sales Price	Sales price of properties within the sample population.	Property Appraiser
Rented	Yes or no attribute based on differences in the site address and the owner address.	Property Appraiser
Tree Canopy Cover	Land cover classification data taken from an unpublished urban forest analysis.	Landry et al., unpublished data
CanopyCollection	New property boundary layer capturing all tree canopy originating within the property's original boundary	Original Data
Property Canopy	Tree canopy cover collected within the CanopyCollection later.	Original Data
Neighborhood Canopy	Tree canopy cover collected within a 200 meter buffer of the property.	Original Data

Figure 2: Tree Canopy Collection Methods

Tree Canopy Collection Methods

After the survey results were compiled, the proper attributes were added to each record, and the spatial analysis had been completed, the resulting sample population layer with all the new attributes was exported to Microsoft Access. After checking for accuracy and fixing errors, the records were then uploaded to IBM SPSS for analysis. In SPSS, the survey responses were cross tabulated using the Pearson Chi-Square Contingency test based on several specific attributes: demographic information, property value, rented/owned, Likert statements, tree benefits and

drawback responses, house condition, and landscape condition, and percent canopy cover for both the parcel and neighborhood. Each of these attributes was chosen because of its direct relationship to the research hypotheses. The chosen attributes and questions were cross tabulated and correlated with the following portions of the survey: Tree benefits and drawbacks, Opinions about trees in your neighborhood, Tree/Outdoor experience, Property history, and Demographic information. In terms of correlation, the Spearman's correlation was used due to the ordinal nature of many of the survey questions and attributes such as the Likert Statements and the various attributes collected on the number of trees or house characteristics.

In addition, several attributes such as the canopy cover percentages and sales price were analyzed by comparing medians as well as calculating the 95% confidence intervals to determine statistical significance. By utilizing this type of analysis, the median sales price, property canopy cover and neighborhood canopy cover could be calculated and shown alongside the frequency with which respondents agreed or disagreed with each Likert statement. This also provided the opportunity to double check significant differences in responses that were found by comparing the column proportions in the cross tabulations. For those statements which reported large differences in medians for canopy cover, sales price, number of trees, and house/landscape condition, confidence intervals were calculated to depict the significant difference between each response and the various attributes that response was analyzed against. The confidence intervals were calculated using a standard equation: $CI = \pm(Z * (\sigma \div \sqrt{N})))$ where CI is confidence interval, Z is the 1.96 confidence level, σ is standard deviation, and N is the sample size.

RESULTS

It is the goal of this thesis to fully understand how the ecosystem services and disservices affect opinions about the value of the urban forest and whether a more positive or negative outlook on the urban forest exists in the city of Tampa. The study examined this relationship through the use of a mailed questionnaire sent out to residents of 2,000 properties in the City of Tampa. The results from this survey are organized into six sections: demographic information, tree benefits and drawbacks, opinions about trees in neighborhoods, tree/outdoor experience, property history, and tree canopy cover. A total of 400 out of 2,000 surveys were returned with full or mostly completed responses resulting in a 20% return rate. Of the 400 surveys received, only 319 had viable addresses that could be linked to the property and tree canopy data and hence were included in the analyses. Of those 319, it was determined that 273 were owned by the current occupants while 46 were rented. To utilize as many survey responses as possible, all 400 were analyzed for general responses, but only the 319 that matched with properties were included in the analysis pertaining to tree canopy and landscape preferences.

Demographic Information

Of the 400 surveys, 141 respondents identified as male, 213 identified as female, 7 identified as both or jointly participated in the questionnaire, and 39 did not indicate one way or the other (Table 2). The respondents indicating a female gender identity comprised the majority of the responses at 53.3%. Considering the City of Tampa's population is 51.1% females, the respondent percentage appears to be representative of the study area as a whole (City of Tampa: Demographics 2015). While there is not much variability between the City of Tampa and survey respondents in

34

terms of female population percentage, the percent of males responding to the survey, 35.3%, was

much lower than the City of Tampa's 48.9% as of 2015. Due to the 9.8% of surveys containing no

data, it is possible that the percent of males, females, and both are higher or lower than what they

appear.

Table 2: Respondent Gender Identities

Gender Identity	Responses	Percent of Responses
Male	141	35.3%
Female	213	53.3%
Both	7	1.8%
No Data (N.D.)	39	9.8%
Total:	400	100%

There were 428 responses to the race and ethnicity identification portion of the

questionnaire. The higher number of responses in comparison to the total number of surveys

received was attributed to multiple responses in different categories where people identified as more

than one ethnicity. Table 3, shows the number of responses and percent for each of the categories

listed. The results were as follows: 312 respondents identified as White/Caucasian (72.9%), 51 as

Hispanic/Latino (11.9%), 20 as Black/African American (4.7%), 25 as Asian/Asian American

(5.8%), 2 as Native American/American Indian, 3 as Other, and 15 gave no response. Comparing

these values to the City of Tampa as a whole, the number of respondents was higher in terms of

White/Caucasians than what is reported for the City of Tampa which was 62.9%. The

Black/African American respondents, 4.7%, were underrepresented in the sample population

compared to the 26.5% that is reported for the City of Tampa., Similarly, the Hispanic/Latino

population, 11.9%, is also underrepresented compared to the 23% reported for the Tampa

population. Asian/ Asian Americans and Native Americans/American Indians were close to reports

for the City of Tampa making them representative of their respective populations.

Table 3: Reported Ethnicities of Respondents

Race/Ethnicity	Responses	Percent of Responses
White/Caucasian	312	72.9%
Hispanic/Latino	51	11.9%
Black/African American	20	4.7%
Asian/Asian American	25	5.8%
Native American/American Indian	2	0.5%
Other	3	0.7%
No Data (N.D.)	15	3.5%
Total:	428	100%

The ages reported by respondents were broken into 5 categories shown in Table 4. The ages for the survey respondents were found to be: one 18 to 21 year old (<1%), 168 in the 22 to 35 year old category (42.7%), 90 in the 36 to 45 year old category (22.9%), 84 in the 46 to 55 year old category (21.4%), and 50 in the 56 year and older category (12.7%) for a total of 393 responses. The sample population comprised of homeowners and renters in order to closely resemble what would be sampled in a hedonic pricing study. This resulted in residents under 21 years old being almost completely unrepresented in the sample due to the fact that persons under 18 cannot legally own property. The largest demographic responses of 42.7% appears to be consistent with 22 to 35 year old category becoming first time home owners and the majority of people searching for places to live at any given time. This also excludes many 56 and up citizens from being equally represented because this demographic is more likely to be settled in homes they have already purchased.

Table 4: Reported Ages of Respondents

Age Bracket	Responses	Percent of Responses
18-21	1	0.3%
22-35	168	42.7%
36-45	90	22.9%
46-55	84	21.4%
56 and up	50	12.7%
Total:	393	100%

In addition to the demographic information collected through survey responses, each property in the sample population had sales amount and rented/owned attributes collected from the property appraiser's parent data. Of the 319 records which were matched with properties in ArcGIS, 273 (85.6%) were owned by their tenants while 46 (14.4%) were rented by the current occupants. According to the census bureau's website, the City of Tampa reported an owner-occupied housing unit rate of 49.1% from 2011-2015 (City of Tampa: Demographics 2015). Based on the information provided by the census website, it would appear that the sample population has a much larger percentage of homeowners compared to the city as a whole. The city of Tampa also reported a median house value of $160,300 USD for owner-occupied housing units from 2011-2015. Compared to the sample population, which has a median value of $195,000 USD for the owner-occupied properties, the median house value for the city of Tampa is less than what is represented in the sample population.

Tree Benefits and Drawbacks

The first portion of the survey consisted of free response questions asking respondents to list the top two or three qualities that they would identify as tree benefits and tree drawbacks (See Appendix A). Analysis required manually sorting each response into broader categories of responses, with some of the categories being derived from previous surveys (Lohr et al., 2004; Avolio et al., 2015; Conway and Yip, 2016). Several categories throughout the tree benefits and drawbacks seemed to overlap such as environmental benefits and combat global warming as well as storm damage, falling trees, and potential damage. These were separated for analysis because each has a slightly different consequence and were specifically stated by the respondents. An example of this would be shade and lower utility bills. While the two are not always directly related, some respondents attributed their preference for shade with decreased utilities bills during hotter months. The same

can be said for damage, with many respondents distinguishing a difference between every day damage from roots or falling limbs and damage from storms in the area. Responses were separated into broad categories that could capture as many responses as possible, but to recognize sub-groups when possible for analysis purposes (i.e. damage: storm damage, root damage, potential damage, and falling trees).

The tree benefits were sorted into 21 different categories with 1,028 total responses as shown in Table 5. The question asked for two or three of the top qualities those taking the survey would identify as benefits meaning that the number of responses should be between 800 and 1200. The actual number of responses shows that on average every survey provided at least two qualities identified as benefits. To calculate the percentage each category represented of the overall sample, each category was divided by the total number of surveys rather than the total number of responses. Of the categories listed in the table, the most prominent were shade, accounting for 80.5% of the responses, and aesthetics, accounting for 65.3% of the responses. Considering shade and aesthetics are two benefits that are easily identifiable, it is not surprising that they comprise over half of the responses. Interestingly, many of the qualities that require a more in-depth knowledge of ecosystem processes, such as storm water absorption and combatting global warming, were not as heavily represented as categories when compare to attracts wildlife or shade or aesthetics. One category that was mentioned relatively few times was the ability for trees to increase the value of the respondent's property which was expected to comprise a larger percent of the responses.

Table 5: Reported Tree Benefits

Response Category	Responses	Percent of Responses
Shade	322	80.5%
Aesthetic	261	65.3%
Air Quality	79	19.8%
Oxygen Production	64	16.0%
Attract Wildlife	48	12.0%
Privacy	38	9.5%
Habitat for Animals	34	8.5%
Soil Stabilization	25	6.3%
Combat Global Warming	20	5.0%
Provide Feelings of an Established Neighborhood	20	5.0%
Environmental Benefits	19	4.8%
Fruit/Flowers	18	4.5%
Create Calming Effect	15	3.8%
Lower Utilities	15	3.8%
Sustainable	13	3.3%
Increase Value	12	3.0%
Room for Activities	11	2.8%
Protection from Elements	7	1.8%
Biodiversity	5	1.3%
Absorb Storm Water	1	0.3%
Wood	1	0.3%
Total:	400	100%

Tree drawbacks were analyzed in the same manner as the tree benefits. This question, however, saw a much lower number of responses than the preceding question. As shown in Table 6, the total number of responses was 829 split among 20 categories. Many of the categories of reported drawbacks were similar to each other such as storm damage, potential damage, and falling trees but were separated based on specific mentions of how the tree was causing damage and under what circumstance. Of the 20 categories, falling debris, maintenance, and root damage made up the majority of responses accounting for 51.3%, 40.8% and 25.8%, respectively. Falling debris was the single category that saw the largest number of responses at 205. However, damage in some from (root damage, potential damage, storm damage, and falling trees) was mentioned by 244 respondents or 61%, making damage from trees the largest concern among the respondents to this portion of the survey.

Table 6: Reported Tree Drawbacks

Response Category	Responses	Percent of Responses
Falling Debris	205	51.3%
Maintenance	163	40.8%
Root Damage	103	25.8%
Potential Damage	70	17.5%
Attracts Wildlife	54	13.5%
Storm Damage	50	12.5%
Allergies	48	12.0%
Cost to Maintain	34	8.5%
Shade	27	6.8%
Falling Trees	21	5.3%
Space Restrictions on Property	14	3.5%
Disease	7	1.8%
Hindered View	7	1.8%
Invasive Species	5	1.3%
Neighborhood Collaboration	5	1.3%
City Restrictions	5	1.3%
Power Line Interference	5	1.3%
Unappealing	3	0.8%
Water Demand	2	0.5%
Ecosystem Protection	1	0.3%
Total:	400	100%

Opinions about Trees in Your Neighborhood

The second part of the questionnaire comprised 21 questions/statements and five possible answer choices, based on the Likert scales, ranging from strongly agree to strongly disagree. Table 7 shows the number of responses for each answer for every question along with the adjoining percent, total, and median. The median proved to be a useful measure in determining the general consensus of where resident opinions were concentrated. To calculate this, the answers were given a value one to five: 1- strongly agree, 2- agree, 3- neither agree nor disagree, 4- disagree, and 5- strongly disagree. The responses were then run through SPSS to quickly capture the sum and median of each statement. The higher the median, the more strongly the sample population disagreed with the statement and the lower medians resulted in a stronger agreement with the statement. Out of the 20 questions, there were none that received less than 393 out of 400 possible responses.

Table 7: Likert Responses (For analysis the 5 categories were assigned number to ease the analysis process. 1-Strongly Agree, 2- Agree, 3- Neither Agree Nor Disagree, 4- Disagree, 5- Strongly Disagree)

Questions	Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree	Total	Median
Trees combat the effects global warming.	**211** **53.4%**	117 29.6%	54 13.7%	6 1.5%	7 1.8%	395 100%	1
Trees increase the value of the property on which I reside.	**186** **46.7%**	120 30.2%	74 18.6%	14 3.5%	4 1%	398 100%	2
Trees help stabilize the soil and prevent erosion.	**222** **56.5%**	117 29.8%	45 11.5%	8 2%	1 0.3%	393 100%	1
Ideally, I would like to live in a neighborhood with large trees.	**237** **59.3%**	112 28%	38 9.5%	8 2%	5 1.3%	400 100%	1
Ideally, I would like live in a neighborhood with a tree in front of most houses.	**186** **46.6%**	124 31.1%	68 17%	13 3.3%	8 2%	399 100%	2
Neighborhoods with trees are more attractive than those without trees.	**281** **70.3%**	91 22.8%	22 5.5%	2 0.5%	4 1%	400 100%	1
Trees provide benefits that I want in my neighborhood.	**213** **53.4%**	156 39.1%	26 6.5%	2 0.5%	2 0.5%	399 100%	1
Trees create a physical hazard (such as falling branches) I do not like in my neighborhood.	21 5.3%	108 27.3%	103 26%	**128** **32.3%**	36 9.1%	396 100%	3
Trees make a neighborhood look less tidy.	6 1.5%	25 6.4%	54 13.7%	**191** **48.6%**	117 29.8%	393 100%	4
Trees make a neighborhood less safe (such as blocking views, create hiding places).	4 1%	24 6%	66 16.6%	**202** **50.8%**	102 25.6%	398 100%	4
I do not want trees in my neighborhood because they contribute to my allergies.	5 1.3%	6 1.5%	48 12.1%	160 40.3%	**178** **44.8%**	397 100%	4
I would like my current neighborhood to have more trees.	70 17.6%	88 22.1%	**159** **39.9%**	66 16.6%	15 3.8%	398 100%	3

Table 8: Likert Responses Cont.

Questions	Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree	Total	Median
Ideally, I would like to see at least one tree when I look out my window.	**194** **48.7%**	167 42%	26 6.5%	7 1.8%	4 1%	398 100%	2
Having at least one tree at my home is important to me.	**222** **55.9%**	134 33.8%	31 7.8%	5 1.3%	5 1.3%	397 100%	1
Trees require more work than they are worth.	9 2.3%	10 2.5%	61 15.4%	**163** **41.2%**	153 38.6%	396 100%	4
I like the cooling benefits trees provide by shading my house in the summer.	**248** **62.5%**	128 32.2%	18 4.5%	3 0.8%	0 0.0%	397 100%	1
Trees attract wildlife I like to see in my yard.	**164** **41.2%**	120 30.2%	76 19.1%	26 6.5%	12 3%	398 100%	2
I do not like trees in my yard because their roots cause problems (such as interfering with pipes, cracking sidewalks).	19 4.8%	67 16.8%	129 32.4%	**130** **32.7%**	53 13.3%	398 100%	3
When purchasing or leasing my home, the presence of trees influenced my decision to live here.	**131** **33.1%**	126 31.8%	71 17.9%	56 14.1%	12 3%	396 100%	2
Trees hinder the view of the road from my home.	7 1.8%	39 9.8%	55 13.9%	**177** **44.7%**	118 29.8%	396 100%	4
Allergens associated with trees affect the amount of time I spend outside.	11 2.8%	27 6.8%	45 11.3%	141 35.4%	**174** **43.7%**	398 100%	4

The results from the analysis of the Likert scale questions showed a wide variety of median scores ranging from one to five. Responses indicated strongly agreed/agree to many of the statements, suggesting that the sample population displayed an understanding that trees combat global warming and provide other benefits such as increased property value and shade during the

hot summer months. Despite a majority of respondents strongly agreeing that trees increased the value of their property, increased value was not as strongly represented in the tree benefits portion of the survey, possibly indicating that although they agree with the statement it is not as important to them as other tree benefits. This could also mean that increased value was not recognized by a majority of respondents until presented to them as a benefit. In addition, a majority of respondents felt that trees were aesthetically pleasing, important to have in their neighborhood, and would ideally like to have trees in their neighborhood and at least have one on their own property. The results from these Likert statements show an overall appreciation and positive outlook on trees in both neighborhoods and in general.

The following statements are representative of the disagreed/strongly disagreed with categories. While there were no statements that received a median of five, or strongly disagreed, there were six that scored a four when calculating the median. These statements showed that respondents did not agree that trees make their property less tidy, hinder their view blocking the landscape or make their neighborhood less safe. Additionally, respondents disagreed that the presence of trees affected their time outside due to allergens or that they did not want trees because of their allergies. Overall respondents disagreed with the negative statements concerning trees and suggests that trees are not more work and do not cause more problems than they are worth, continuing the positive perception of trees seen from the agreed upon statements.

There were a few statements that respondents neither agreed nor disagreed with such as trees creating a physical hazard, people wanting more trees in their neighborhood and that trees cause root problems which lead to damage. These responses were somewhat surprising due to the large number of respondents that indicated root damage and physical hazards created falling branches as top concerns about trees in their response to the tree drawbacks question. In fact, root

damage and falling debris ranked in the top three responses for the drawbacks of trees. A possible explanation for this mixed response is that although people rate these factors high on their list of drawbacks, they are not strong enough to deter their view of trees or discourage them from wanting them in their neighborhoods.

Tree/Outdoor Experience

The third portion of the survey focused on respondents' experiences with trees and spending time outdoors. It featured five questions that were a mixture of free response and yes or no questions. The first question which asked respondents if anyone in their household suffered from allergies associated with trees or vegetation received 389 total responses or a 97.3% response rate. Out of the 389 responses, 195 (50.1%) indicated someone in their household was affected by allergies and 194 (49.9%) indicated no one had such aliments. The allergen question was accompanied by two adjoining questions asking respondents how many days they spend outside a week as well as how much time they spend doing various activities.

The question concerning how many days spent outside, the total responses were found to be 400, or a 100% response rate, with answers varying from zero to seven as shown in Table 9. Out of the 400 responses, 274 respondents indicated they spent a majority of their week outside (over 4 days) which accounted for 68.5% of the sample. Out of all the categories, the largest number of responses indicated that respondents spent 7 days, or their entire week, outside for a time period longer than one hour. To further understand how the respondents spent their time outside they were asked to indicate how long they spent doing specific activities. These activities, listed in Table 10, are: gardening, exercising, at a park, walking a pet, around my neighborhood, and somewhere that is not my neighborhood. Gardening had 378 total responses, exercising 376, at a park 368, walking a pet 370, around my neighborhood 376, and somewhere outside that is not my

44

neighborhood received 374 responses. Of the total responses for each category, the largest percent of responses for gardening was 0-30 min spent outside, exercising was 30 minutes to one hour, at a park was 0-30 min, walking a pet was none, around my neighborhood was 0-30 min, and somewhere outside that was not my neighborhood was more than 1 hour.

Table 9: Reported Days Spent Outside

Days Spent Outside	Responses	Percent of Responses
0	20	5.00%
1	11	2.75%
2	48	12.00%
3	46	11.50%
4	44	11.00%
5	68	17.00%
6	40	10.00%
7	122	30.50%
Total:	400	100%

Table 10: Reported Time Spent Outside

	None	0-30 Min	30 Min- 1 Hour	More Than 1 Hour	Total:
Gardening	79 (20.90%)	**133 (35.19%)**	86 (22.75%)	80 (21.16%)	378 (100%)
Exercising	47 (12.50%)	111 (29.52%)	**133 (35.37%)**	85 (22.61%)	376 (100%)
At a Park	95 (25.82%)	**102 (27.72%)**	97 (26.36%)	74 (20.11%)	368 (100%)
Walking a Pet	**158 (42.70%)**	98 (26.49%)	70 (18.92%)	44 (11.89%)	370 (100%)
Around My Neighborhood	39 (10.37%)	**143 (38.03%)**	125 (33.24%)	69 (18.35%)	376 (100%)
Somewhere Outside That is Not My Neighborhood	61 (16.31%)	105 (28.07%)	93 (24.87%)	**115 (30.75%)**	374 (100%)

In addition to asking respondents how they spent their time outside, they were also asked to indicate if they spent more time in their neighborhood or in other public places. Table 11, lists the 399 responses by the following categories: neighborhood, somewhere other than my neighborhood which was then split into parks and other public spaces, both, neither, and no data. A majority of respondents, 52.13%, indicated that they spent more time in their neighborhood when outside.

45

Respondents who indicated that they spent more time in places other than their neighborhood, which were reported parks and other public places which accounted for 26.56% of the responses. In addition, 15.54% felt that they spent an equal amount of time outside in both public areas and their neighborhood while 3.26% indicated they spent time at neither location. The remaining 2.51% failed to indicate either location. The final question of this section asked whether the respondent or anyone they knew had been injured as a result of falling branches or trees. Of the total 383 responses, 43 indicated they or someone they knew had been injured while 340 indicated injuries of this kind had not occurred to their knowledge.

Table 11: Reported Time Spent in Neighborhoods or Parks

When Outside, Do you Spend More time in Neighborhood or at a Park?	Responses	Percent of Responses
Neighborhood	208	52.13%
Somewhere Other Than My Neighborhood:		
Parks	42	10.52%
Other Public Spaces	64	16.04%
Both	62	15.54%
Neither	13	3.26%
No data	10	2.51%
Total:	399	100%

Property History

This section of the questionnaire focused on the property's history prior to the respondent's participation in this survey. The three questions that comprised this section asked the respondents to indicate how many trees are in their front yard between the house and street, if they had planted or removed trees since purchasing or renting their home, and if the home had suffered any damage due to falling trees or branches as a result from heavy winds or rain associated with severe weather. Table 12 shows the total responses for the first question concerning the number of trees in the respondent's front yard, the front yard was specifically targeted due to the lack of imagery available

to assess backyard trees. The smallest number of trees in a front yard was reported to be zero while the greatest was 15 trees. The most common number of trees in the respondent's front yard was two with a total of 107 responses (26.75%), which was followed by one tree in the front yard at 84 responses (21%). The median number of trees calculated form the attributes collected via Streetview was also found to be two, meaning that what respondents identified as a tree matched what the number the study collected.

Table 12: Number of Trees in Front Yard

Number of Trees in Front Yard	Responses	Percent of Responses
0	34	8.50%
1	84	21.00%
2	**107**	**26.75%**
3	70	17.50%
4	47	11.75%
5	23	5.75%
6	16	4.00%
7 or More	19	4.75%
Total:	400	100%

The second question asked residents to indicate if they had either planted or removed a tree since their initial purchase or lease of the property. The question did not distinguish between planting or removal in order to eliminate the possibility of respondents not answering the question based on notions of guilt or fear of inquiry about their removal. A total of 391 responses were collected from this question with 157 indicating that they either had planted or removed a tree while 234 indicated they had no engaged in either activity. The final question concerning property history captured information on previous injury from trees during times of severe weather. Much like the previous question, 391 respondents indicated whether or not they or someone they knew were injured in the past by a tree. Of these 391 responses, 35 respondents indicated that they or someone they knew had been injured while 356 indicated this had not occurred to them or someone else.

Tree Canopy Cover

The final section addressed the collected tree canopy data. Although 400 survey responses were received, only 319 of those were linked to an address in ArcGIS. The number of tree canopy pixels for each CanopyCollection polygon was divided by the total pixels in each polygon to determine the percent of canopy cover for each property. The canopy cover data used for this was collected from a 2016 land cover classification that was created for the 2016 Tree Canopy and Urban Forest Analysis (Landry, in-press). The results of this process showed that no property in the sample had above 68% of their land covered by trees, with the median canopy cover being 15.5%. The canopy cover within the 200 m buffer had a maximum value of 63% with a median of 17.8%. Both the CanopyCollection and the neighborhood canopy results were as low as zero percent for the degree of canopy cover, which suggests that not all properties sampled had a tree or any tree canopy on their lot. The lower maximum value and lower median for the neighborhood canopy compared to the property area suggests that the surrounding neighborhood for each property may have less canopy than the property itself. This could also be attributed to the presence of roads and other impervious surfaces falling within the buffer area.

ANALYSIS

The goal of this thesis was to examine the relationship between resident opinions and the value residents place on trees. Five hypotheses related to the urban forest and its relationship with the people of Tampa were developed to test how resident perceptions affect how they value trees. For analysis, the hypotheses were split into three sections for review: The Effects of Tree Drawbacks, Affluence and Sociodemographic Factors, and Tree Canopy Cover. The section on the effects of tree drawbacks primarily focuses on the first and second hypotheses which were concerned with who reports more tree drawbacks and how drawbacks affect which trees are favored more. The section on affluence and sociodemographic factors focus on hypotheses three and four, which target homes with lower assessed value and how ethnicity effects canopy cover. Finally, the tree canopy section deals primarily with the final hypothesis which explores the relationship between purchase/rental decision and canopy cover.

The Effect of Tree Drawbacks

This section assesses the opinions of renters and homeowners about tree drawbacks as well as the preference for trees based on location. Specifically, this section explores the first and second hypotheses which are as follows: "It is hypothesized that home owners are more likely than renters to report tree disservices due to high maintenance costs, and potential damage. Additionally, it is hypothesized that homeowners will likely report more negative opinions of trees compared to renters." (H1) and "It is hypothesized that because neighborhood trees have fewer drawbacks such as property damage, residents will favor neighborhood trees more than trees on their property." (H2). To determine what kind of relationship exists between tree drawbacks, opinion of trees, and

preference based on location, several sections of the survey were analyzed and cross tabulated with each other.

Hypothesis 1

The drawbacks associated with trees are often those that cause harm to residents or their property (Wang et al., 2015; Randrup et al., 2001; Cui and Caracoglia, 2016; Conway and Yip, 2013). Considering this, it was important to understand what the residents of Tampa deemed as the most important drawbacks they associated with trees. The results section showed that the total number of tree drawbacks that were reported by respondents was 829. Of those, 646 (77.9%) were related to costs, maintenance, some type of damage, and falling debris. To determine whether homeowners did express cost/maintenance and damage as their top drawbacks, the responses to this question were compared to the rented attribute for each respondent. Table 13, shows the difference in responses between renters and owners. As expected, homeowners reported cost/maintenance and damage as drawbacks more frequently than renters. This is supportive of the current knowledge found in the literature, or maybe due to the division between homeowners and renters in the sample population of 85.6% to 14.4% respectively.

Table 13: Tree Drawbacks Reported by Renters and Homeowners

Tree Drawbacks	Renters	Homeowners
Cost/Maintenance	32%	43%
Damage	37%	45%

In addition to analyzing how the reported tree drawbacks differed between renters and owners, these two groups of respondents were also examined to determine who reported more negative opinions of trees. The Likert statements concerning root problems, physical hazards, trees

being less tidy/safe, trees contributing to allergies, and trees being more work revealed more

negative opinions about trees. The results from Table 6 show that the overall opinion of trees was

overwhelmingly positive, with many respondents, both renter and homeowner, disagreeing with the

negative statements about trees. Additionally, there proved to be no significant difference between

renter and owner responses at the .05 level which was determined using the Pearson Chi-Square

Contingency test in SPSS. An example of these analyses are shown in Table 14 which depicts renter

and homeowner responses to the negative Likert statement "Trees create a physical hazard I do not

want in my neighborhood". To determine if there was a statistical difference, column proportions

were compared to each at the .05 level. This was true for both the negative statements listed above

as well as the more positive statements such as "I prefer to live in a neighborhood with large trees".

The higher rate of tree drawbacks reported by homeowners lends supports for the first part of

hypothesis one, however, the lack of statistical difference between homeowner responses and renter

responses to the negative statements about trees does not offer support for the second part of the

hypothesis.

Table 14: Renter/Homeowner vs. Negative Likert Statement Example

| Physical Hazards vs. Rented			
	Rented		Total
	N	Y	
Strongly Agree	17 a	0 a	17
Agree	72 a	8 a	80
Neither Agree Nor Disagree	72 a	13 a	85
Disagree	84 a	20 a	104
Strongly Disagree	24 a	5 a	29
Total	270	46	316
Each subscript letter denotes a subset of Rented attribute whose column proportions do not differ significantly from each other at the .05 level.			

Hypothesis 2

It was hypothesized that because neighborhood trees have fewer drawbacks such as property damage, residents will favor neighborhood trees more than trees on their property (H2). To determine whether residents favored trees based on their location, median canopy cover was cross tabulated with seven Likert statements that specifically mentioned trees in/around the respondents' neighborhood. The cross tabulation graphs, shown in Figure 3, align each of seven Likert statements with the corresponding distribution of canopy according to how residents responded to the particular statement.

By comparing the medians of both the neighborhood canopy cover and the property canopy cover, it is possible to see if responses correlate with higher percentages of trees in the respondents' neighborhoods. This served as a measure to determine preference for neighborhood trees over property trees. In general, there was no trend that appeared in terms of strength of agreement/disagreement and the percent of canopy cover on respondents' properties or within 200 meters of their homes. Additionally, the 95% confidence intervals calculated for both the property canopy cover and neighborhood canopy cover show that there was no statistically significant difference between neighborhood and property trees. One interesting occurrence was that those who strongly agreed/agreed for trees being Less Safe and Less Tidy had higher property canopy cover than neighborhood; this was the exact opposite for the majority of the other cross tabulations. It is possible that this suggests that respondents who strongly agreed with those statements tend to have a higher rate of canopy cover and because of this, tend to perceive this drawbacks of trees more than residents with lower rates of canopy cover. The confidence intervals show that there was no significant difference between neighborhood canopy cover and property canopy cover for

52

responses to the Likert statements pertaining to neighborhoods. Due to this, it would seem that the

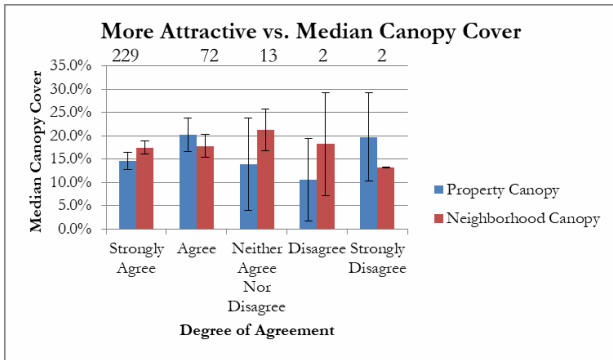analysis does not provide enough support to accept the hypothesis.

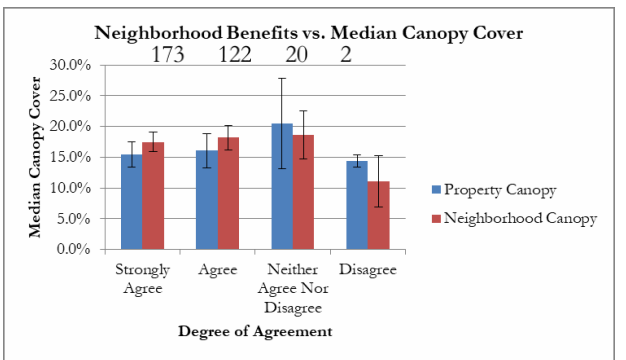## Figure 3: Neighborhood Likert Statements vs. Median Canopy Cover
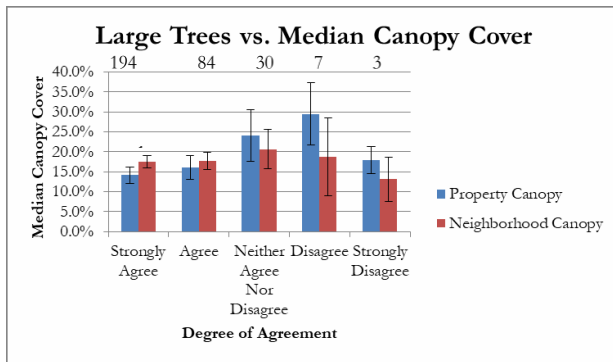
1) Ideally, I would like to live in a neighborhood with large trees.
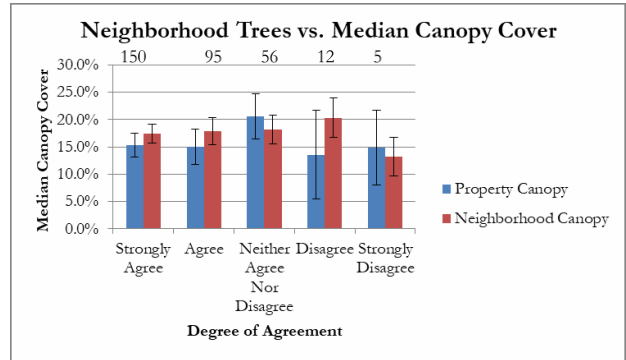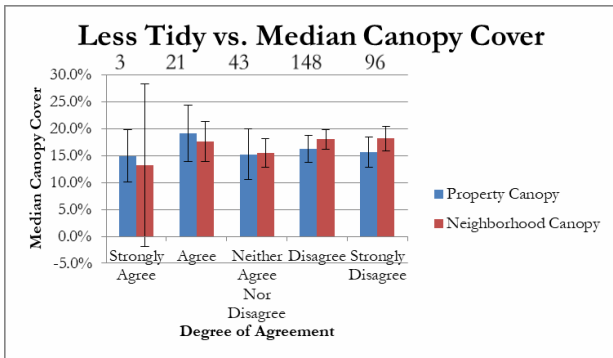

2) Ideally, I would like to live in a neighborhood with a tree in front of most houses.
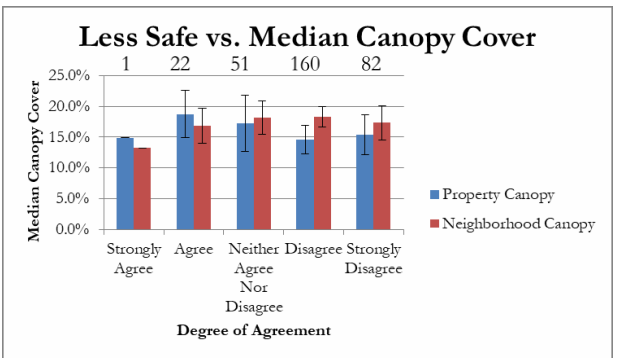

3) Neighborhoods with trees are more attractive than those without trees.
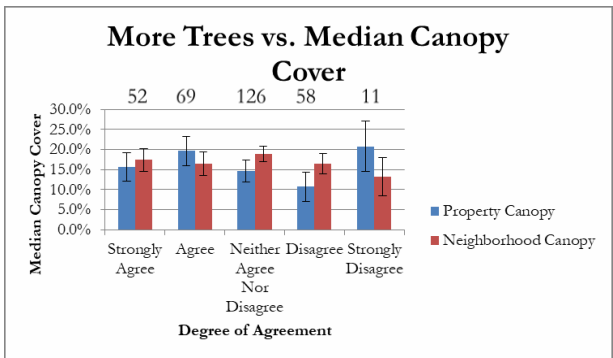

4) Trees provide benefits that I want in my neighborhood.

5) Trees make a neighborhood look less tidy.

6) Trees make a neighborhood less safe.

7) I would like my current neighborhood to have more trees.

54

Affluence and Sociodemographic Factors

Understanding the characteristics of the people included in the sample population is important in determining how their perceptions might affect the urban forest. Specifically, the level of affluence among respondents and their respective ethnicities were hypothesized to be important attributes based on the available literature. Hitmough and Bonugli (1997), Fraser and Kenney (2006), Dobbs et al. (2014), and Heynen et al. (2014) provide evidence to support differences among both affluence and ethnicity. These attributes are used test the following hypotheses: "It is hypothesized that respondents living in homes with lower assessed values will express more negative opinions of trees such as cost and maintenance being reported as drawbacks" (H3) and "It is hypothesized that resident opinions about trees will differ between racial/ethnic groups such as African Americans, Hispanic/Latinos, and White/Caucasians. It is also hypothesized that tree cover percentages at resident properties will be different between racial/ethnic groups" (H4).

Hypothesis 3

It was hypothesized that respondents living in homes with lower assessed values will express more negative opinions of trees such as cost and maintenance being reported as drawbacks (H3). The sales prices of homes were cross tabulated with the Likert statements to determine how these responses were distributed according to sales price. The sample population included a wide variety of house values ranging from well under $100,000 USD to above $3,000,000 USD. Table 15 shows the distribution of sale prices for the sample population grouped by $100,000 increments. The decision to sort the sample population in this manner was due to the wide array of values obtained making it difficult to quantify the data and cross tabulate it with other survey responses if left

unsorted. The table shows that the majority, or 74%, of the sample population had purchased/rented homes with values up to $300,000, with homes between $100,000 and $200,000 narrowly being the largest represented category. Due to the distribution of responses it was difficult to determine how sales price factored in to opinions of trees. The concentration of sale prices at the lower end of the spectrum hindered the ability to determine changes in distribution among Likert response, this resulted in exploring different methods to determine the relationship between sales price and the opinion of trees.

**Table 15: Sales Prices of Homes Based on $100,000 Increments**

Sales Price Categories	Responses
0 ($0-$100,000)	88 (27.6%)
1 ($100,001-$200,000)	**92 (28.8%)**
2 ($200,001-$300,000)	56 (17.6%)
3 ($300,001-$400,000)	35 (11%)
4 ($400,001-$500,000)	16 (5%)
5 ($500,001-$600,000)	8 (2.5%)
6 ($600,001-$700,000)	11 (3.4%)
7 ($700,001-$800,000)	3 (0.9%)
8 ($800,001-$900,000)	0 (0%)
9 ($900,001-$1,000,000)	0 (0%)
10 ($1,000,001 and up)	10 (3.1%)
Total:	319 (100%)

Although many of the Likert statements are cross tabulated with other attributes such as sales price to determine how the distribution of responses varied, it proved to be both more efficient and straight forward to compare the median sales price to each Likert statement. By analyzing the data in this way a clear price value was given that could be easily compared to other Likert statements rather than looking at the number of responses in a given category without knowing the

average value of those responses. Figure 4 shows the cross tabulation graphs for Likert statements that were determined to be representative of the negative opinions of trees and sale prices. Specifically of interest were the Likert statements pertaining to tree hazards, trees make neighborhoods less tidy and less safe, not wanting trees due to allergies, trees requiring more work than they are worth, and root problems. This is because these statements are directly related to the negative opinion of trees. In terms of lower valued homes, it was found that respondents more strongly agreed that trees create a physical hazard they do not want in their neighborhood. However, residents of these same valued homes disagreed that trees make neighborhoods less tidy, that allergies do not factor into wanting trees in their neighborhood, and that root problems keep them from wanting trees. Due to the disagreement concerning allergies and root problems, these responses turn out to be a positive opinion of trees rather than negative ones. This would result in more positive opinions of trees than negative ones for homes with lower sales prices. The rest of the Likert statements provided no pattern with which to assume that affluence correlated with similar opinions of trees. Rather it seems that negative responses to trees are more scattered and possibly are related to personal experience instead of a general negative outlook on trees.

The analysis shows that the expectations of respondents of lower assessed value homes having more negative opinions of trees is false. In fact, the cross tabulations graphs suggest that the opposite is true, that residents of homes with higher assessed values are expressing more negative opinions of trees. However, it is important to note that the distribution of responses for these statements increase as the disagreement with each statement increases. This causes the least amount of responses to be in the strongly agree/agree categories while the bulk of the data is in the disagree and strongly disagree categories. The finding that more negative opinions of trees were associated with residents of homes with higher assessed valued does not support the hypothesis.

Physical Hazard vs. Median Sales Price
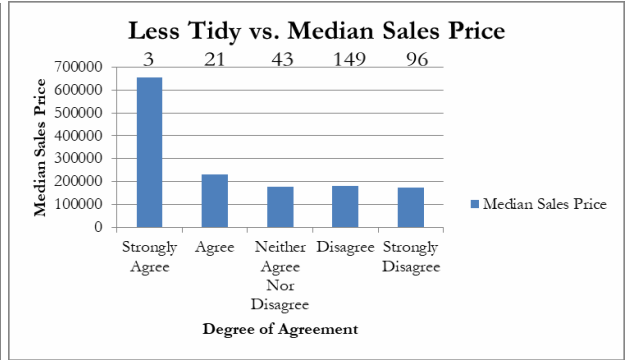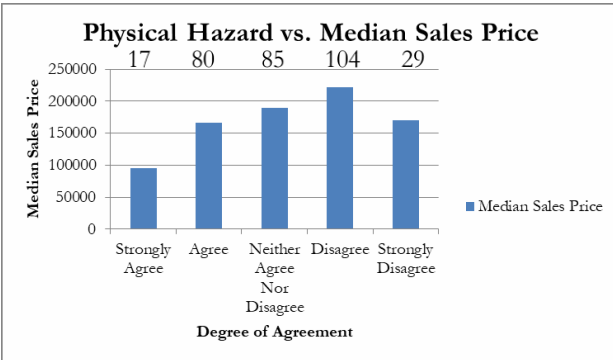
1) Trees create a physical hazard I do not like in my neighborhood.

Less Tidy vs. Median Sales Price

2) Trees make a neighborhood look less tidy.
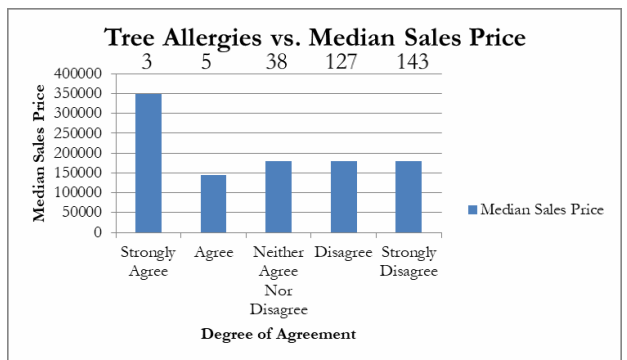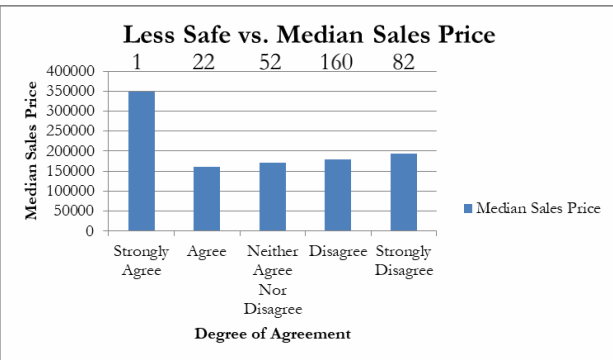
Less Safe vs. Median Sales Price

3) Trees make a neighborhood less safe.

Tree Allergies vs. Median Sales Price

4) I do not want trees in my neighborhood because they contribute to my allergies.

Root Problems vs. Median Sales Price

5) I do not like trees in my yard because their roots cause problems.

More Work vs. Median Sales Price
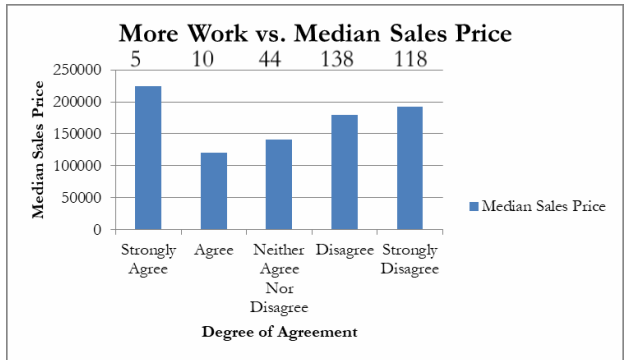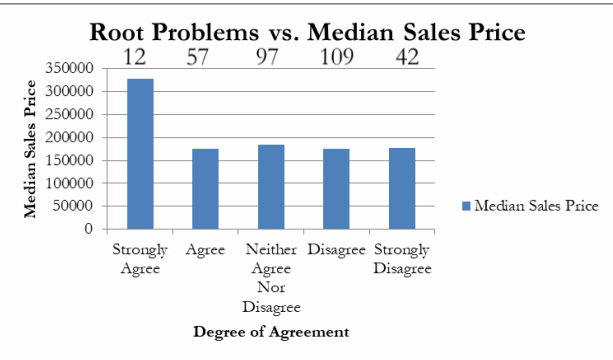
6) Trees require more work than they are worth.

58

Hypothesis 4

It was hypothesized that resident opinions about trees would differ between racial/ethnic groups such as African Americans, Hispanic/Latinos, and White/Caucasians. It was also hypothesized that tree cover percentages at resident properties will be different between racial/ethnic groups (H4). To determine if this was true, Likert responses were cross tabulated with reported ethnicity in hopes of revealing similarities or differences in the distribution of responses. There were several ethnicities that had significantly different responses than other groups. Although Asian/Asian Americans, Hispanic/Latinos, and White/Caucasians each reported a stronger agreement than other groups for various statements, Asian/Asian Americans more frequently reported a significant difference in agreement with the Likert statements which can be seen in Figure 5.

Figure 5 displayed the results from comparing column proportions of each race/ethnicity and their responses to the Likert statements. Each subscript denotes a column proportion that is not significantly statistically different from one another on the .05 level using the Pearson Chi-Square Contingency test in SPSS. In fact, this population of respondents more strongly agreed that: They would like to see at least one tree when they look out of their windows, that having at least one tree on their property is important to them, and that the presence of trees influenced their purchase/rental decision. Additionally, Asian/Asian Americans also reported a significantly stronger disagreement that trees are more work than they are worth along with White/Caucasians. Each of these statistical differences were reported to be significant at the .05 level (Pearson Chi-Square Contingency test).

Window Trees vs. Race/Ethnicity Crosstabulation			
	Asian/Asian American	Black/African American	Hispanic/Latino	White/Caucasian
Strongly Agree	10_a	$7_{b,c,f}$	$14_{b,c,d}$	$114_{b,c}$
Agree	1_a	$6_{a,b,c}$	$12_{a,b,c}$	$96_{b,c}$
Neither Agree Nor Disagree	0_a	0_a	$3_{a,b}$	13_a
Disagree	0_a	1_a	0_a	3_a
Strongly Disagree	$0_{a,b,c}$	$0_{a,b,c}$	0_c	$0_{a,c}$
Each subscript letter denotes a subset of the Race/Ethnicity attribute whose column proportions do not differ significantly from each other at the .05 level.			

1) Ideally, I would like to see at least one tree when I look out of my window.

One Tree vs. Race/Ethnicity Crosstabulation			
	Asian/Asian American	Black/African American	Hispanic/Latino	White/Caucasian
Strongly Agree	10_a	$7_{b,c}$	$17_{a,b,c}$	129_b
Agree	1_a	$5_{a,b}$	$9_{a,b}$	$75_{a,b}$
Neither Agree Nor Disagree	0_a	$2_{a,b,c}$	$3_{a,b,c}$	17_a
Disagree	0_a	0_a	0_a	4_a
Strongly Disagree	$0_{a,b,c}$	$0_{a,b,c}$	0_a	0_b
Each subscript letter denotes a subset of the Race/Ethnicity attribute whose column proportions do not differ significantly from each other at the .05 level.			

2) Having at least one tree at my home is important to me.

More Work vs. Race/Ethnicity Crosstabulation				
	Asian/Asian American	Black/African American	Hispanic/Latino	White/Caucasian
Strongly Agree	$1_{a,b}$	$1_{a,b}$	$0_{b,c}$	1_c
Agree	0_a	0_a	1_a	7_a
Neither Agree Nor Disagree	$2_{a,b,c}$	$2_{a,b,c}$	10_c	22_b
Disagree	7_a	$6_{a,b}$	7_b	103_a
Strongly Disagree	1_a	$5_{a,b,c}$	$9_{a,b,c}$	$93_{b,c}$
Each subscript letter denotes a subset of the Race/Ethnicity attribute whose column proportions do not differ significantly from each other at the .05 level.				

3) Trees require more work than they are worth.

Purchase Decision vs. Race/Ethnicity Crosstabulation				
	Asian/Asian American	Black/African American	Hispanic/Latino	White/Caucasian
Strongly Agree	$7_{a,b}$	$6_{a,b,c}$	6_c	75_c
Agree	1_a	5_a	9_a	74_a
Neither Agree Nor Disagree	$3_{a,b,c,d}$	1_b	7_c	37_c
Disagree	0_a	2_a	$6_{a,b}$	32_a
Strongly Disagree	$0_{a,b}$	$0_{a,b}$	$1_{a,b}$	6_b
Each subscript letter denotes a subset of the Race/Ethnicity attribute whose column proportions do not differ significantly from each other at the .05 level.				

4) When purchasing/leasing my home, the presence of trees influenced my decision to live here.

While the cross tabulations between ethnicity and Likert responses revealed that Asian/Asian Americans primarily had more positive opinions of trees compared to other groups, ethnicity was also compared to the median values of several attributes to further substantiate these findings. Table 16 compares the reported ethnicity to the median number of trees found on their

respective properties, their landscape condition, and the percent of canopy cover both on their property and in their neighborhood. The ethnicity that had the highest median palm value and median conifer value were those who identified as both Hispanic/Latino and Black/African American. For broadleaf trees it was those who identified as White/Caucasian and Asian/Asian American. Landscape condition was highest for those who were both White/Caucasian and Black/African American. Finally, canopy cover directly on one's property and around one's neighborhood was highest with Asian/Asian Americans and those who identified as something other than what was listed respectively.

Table 16: Race/Ethnicity vs. Number of Trees/Canopy Cover

Race/Ethnicity vs. Number of Trees/Canopy Cover						
Race/Ethnicity		**Number Palm**	**Number Conifer**	**Number Broadleaf**	**Property Canopy Cover**	**Neighborhood Canopy Cover**
Asian/Asian American	N	12	12	12	12	12
	Median	0.0	0.0	0.0	**19.9%**	17.0%
Black/African American	N	14	14	14	14	14
	Median	0.0	0.0	1.0	14.5%	**20.1%**
Hispanic/Latino	N	29	29	29	29	29
	Median	0.0	0.0	2.0	15.2%	18.8%
N/A	N	14	14	14	14	12
	Median	0.5	0.0	2.0	16.9%	16.7%
Other	N	2	2	2	2	2
	Median	0.0	0.0	1.5	19.9%	22.0%
White/Caucasian	N	227	227	227	226	227
	Median	0.0	0.0	1.0	15.9%	17.4%
Total	N	298	298	298	297	296
	Median	0.0	0.0	1.3	15.5%	17.8%

With regards to the hypothesis, it is unclear whether different ethnicities express different opinions about trees from one another. Despite Asian/Asian Americans more strongly agreeing with certain statements more than other ethnicities, there does not appear to be a trend between

opinions about trees and race/ethnicity. Additionally, Table 16 does not provide any evidence to support the hypothesis.

Tree Canopy Cover

The final section examines the relationship between tree canopy cover and the decision respondents made to purchase/rent their property. It was hypothesized that there would be a high correlation between residents' purchases and/or rental decisions and the extent of canopy cover from trees originating on their property and/or in their neighborhood (H5). The respondents' decision to purchase/rent their current properties were cross tabulated with both the CanopyCollection and neighborhood canopy buffer layers. By analyzing both the percent of canopy cover from trees originating on the given property and the percent of canopy cover within 200 m, it is possible to discern how purchase decisions were affected by the presence of trees on the property and in the surrounding neighborhood.

Hypothesis 5

Figure 6 shows how canopy cover on residents' properties and in their neighborhoods correlated with their decision to rent/purchase their current homes. It was expected that there would be a high correlation between respondents agreeing with the statement "when purchasing or leasing my home, the presence of trees influenced my decision to live here" and the amount of canopy cover on both the respondents' property and in their neighborhood. The analysis shows that those who strongly disagreed with this statement had higher rates of canopy cover than any other group of respondents. Additionally, property canopy cover was lowest among residents who said they strongly agreed with "when purchasing or leasing my home, the presence of trees influenced my decision to live here". This was surprisingly considering a majority of respondents who answered

this question primarily agreed or strongly agreed that trees influenced their decision to rent/purchase. Although, it is possible that this result is representative of the fact that people chose their property due to the property or neighborhood having fewer trees which they preferred. Higher percent of canopy cover in the neighborhood for those that strongly agree with the Likert statement "when purchasing or leasing my home, the presence of trees influenced my decision to live here" might also suggest a preference for trees that do not fall on their property. The analysis shows that there is not a high correlation between responses to the statement "when purchasing or leasing my home, the presence of trees influenced my decision to live here" and canopy cover, due to this there is not enough support for the hypothesis.

Figure 6: Purchase/Rental Decision vs. Median Canopy Cover
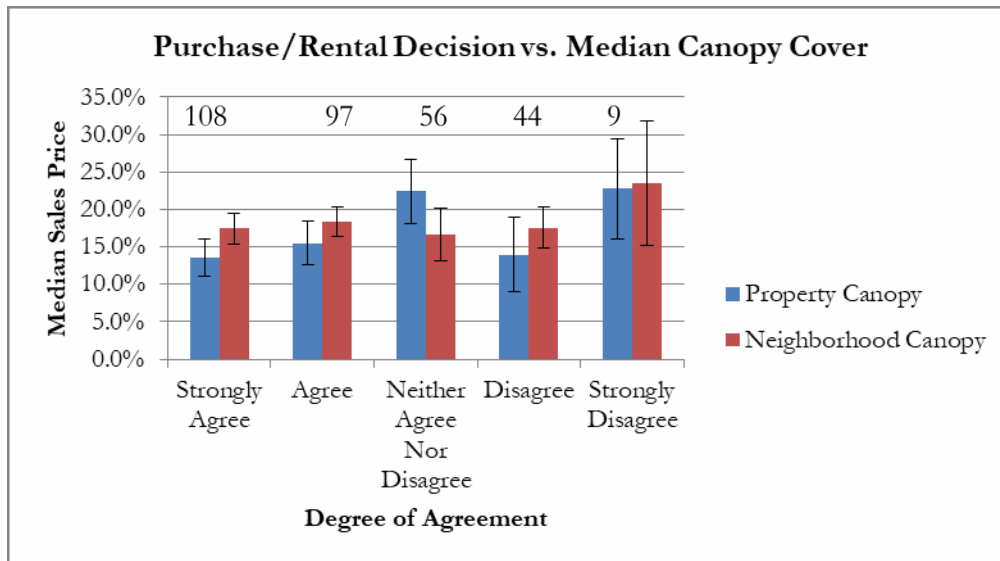
When purchasing or leasing my home, the presence of trees influenced my decision to live here.

DISCUSSION

To determine if certain characteristics of the residents of Tampa affected the value people place on trees, five hypotheses were tested. By utilizing a mailed questionnaire it was possible to capture the opinions of the residents of Tampa based on several aspects of their lives and more importantly on how they perceived trees. The results of the survey show that the respondents to the survey primarily viewed trees in a positive light with most people expressing strong agreement with the positive aspects of trees while disagreeing with the negative aspects. Respondents seemed to value trees mostly for their ability to provide shade as well as their aesthetic value while most respondents said that cost, maintenance, and some form of damage were their highest concerns for trees. Although a majority of respondents agreed trees increase the value of their property, many did not report this as their top two to three drawbacks indicating it may not be a benefit they automatically associate with trees. The fact that damage is one of the highest reported drawbacks is surprising because only 9% of respondents indicated that they had experienced damage on their property from trees. Additionally, respondents indicated that when spending their time outside, they primarily spent that time around their neighborhood. Overall it would seem that respondents preferred having trees on or around their property while simultaneously agreeing that trees provide benefits that far outweigh their drawbacks.

It was hypothesized that home owners are more likely than renters to report tree disservices due to high maintenance costs, and potential damage. Additionally, it was hypothesized that homeowners would likely report more negative opinions of trees compared to renters (H1). From the analysis it is clear this is not so. In addition to the responses being overwhelmingly positive, cross tabulating homeowner and renter responses to the Likert statements showed that there was no

significant statistical difference between them despite homeowners being the majority of the sample population. Although costs, maintenance, and damage associated with trees were the primary drawbacks reported by respondents, it was demonstrated that one group reported more than the other. This suggests that the findings were not what was originally expected. This is surprising due to the fact that much of the literature indicates a preference for street trees over trees found on residents' property due to homeowners bearing 100% of the costs but not receiving 100% of the benefits (Donovan and Butry 2011; Gorman 2004; Hitmough and Bonugli 1997). One reason there might be a lack of statistical difference between renters and homeowners in the sample population is that homeowners are represented more highly than renters. From 2011 to 2015 the city of Tampa reported an owner-occupied housing unit rate of 49.1% (City of Tampa: Demographics 2015). This was much lower than the 85% homeowner rate for those who responded to the mailed questionnaire. It is possible that the lack of renters in the sample resulted in a bias towards homeowner opinions and failed to fully convey the attitudes of renters towards trees. In this scenario, the first part of the hypothesis is accepted while rejecting the second.

It is hypothesized that because neighborhood trees have fewer drawbacks such as property damage, residents will favor neighborhood trees more than trees on their property (H2). This sentiment was also backed by the literature as the first hypothesis which suggested that the benefits of trees to an individual resident might be provided from several surrounding properties while the maintenance and costs of said trees can fall on one person. Due to the lack of drawbacks associated with neighborhood trees, they were expected to be favored more highly. It was anticipated that the evidence to test the validity of this hypothesis would come in the form of costs, maintenance and damage being reported more frequently as drawbacks, as well as higher rates of neighborhood canopy and stronger agreement with statements concerning neighborhood trees. Although the tree drawbacks reported were primarily associated with costs, maintenance, and damage, this seemed to

66

have no effect on the opinions of neighborhood trees compared to trees on residents' property. Infact, the Likert statements were overwhelmingly positive with little to no negative connotation surrounding the opinions of trees. Furthermore, the rate of canopy cover between respondents' properties and their neighborhoods reveal that the median canopy cover was 15.5% and 17.8% respectively, this resulted in higher overall rates of canopy cover directly on resident property. Although comparing median canopy covers for the Likert statements concerning neighborhood attributes showed a slightly higher median cover for neighborhood canopy, differences between the property and neighborhood were not great enough to support hypothesis; in this instance the hypothesis is rejected.

It was hypothesized that respondents living in homes with lower assessed values would express more negative opinions of trees with cost and maintenance being reported as drawbacks (H3). Hitmough and Bonugli found that that support for planting trees is often low among streets with less affluent residents (1997). Unlike their findings, Zhang et al. (2007) found that support for tree programs was associated with: people who knew of the programs, were younger than 56 years old, and made above $75,000 USD a year. This literature suggests that there might be a correlation between lower affluence and negative opinions of trees due to costs, maintenance, and a lack of ability to properly care for trees. The analysis showed that 57.4% of respondents lived in a home that was valued at $300,000 or less and the median sales price for owner-occupied homes was $195,000 USD. The median house value for owner-occupied properties was higher than what was reported for Tampa between 2011 and 2015. With regards to sales price compared to Likert responses the analysis showed that there was a more positive response to trees for homeowners of a property with a lower assessed value. While it was expected that residents in these homes would report more negative opinions of trees in comparison to residents living in homes with higher values, this was not true for our sample population. This could be caused by the primarily positive

responses to trees as well as the fact that a majority of the sample population could be considered lower value homes. Due the finding that the median sales price for respondents who strongly agreed with the negative Likert statements about trees was on average much higher than those who did not, the hypothesis is rejected.

It was hypothesized that different ethnic groups such as African Americans, Hispanic/Latinos, and White/Caucasians as well as residents of different affluence would report similar opinions and tree cover percentages with people from similar demographics (H4). It was expected that responses would be similar within ethnic groups and different between groups based on literature such as Fraser and Kenney (2000) which stated that landscape preferences might be associated with cultural background and tradition. They reported in their findings that out of their focus groups, the Canadians with British ancestry responded more positively to canopy cover. Additionally, Heynen et al. (2006) reported that White/Caucasians had more canopy cover than Hispanic/Latinos in their study. This research, however, has shown that Asian/Asian Americans reported more positive opinions of trees while also having the highest median canopy cover for their properties. The Hispanic/Latino population had higher median canopy cover for their properties and neighborhoods compared to their White/Caucasian counterparts. This is the opposite of what the current literature found in terms of canopy cover. Additionally, although Asian/Asian Americans reported more favorable opinions, there did not to seem to be any other trends among other ethnic groups. Due to this, it is not possible to determine if this is coincidence or if the responses by Asian/Asian Americans are sufficient to accept the hypothesis, in this case the hypothesis is rejected.

It was hypothesized that there would be a high correlation between residents' purchases and/or rental decisions and the extent of canopy cover from trees originating on their property and/or in their neighborhood (H5). This final hypothesis dealt with the hedonic pricing literature

and how purchase/rental decision was affected by canopy cover. The hedonic pricing literature provides a basis for how trees can be valued economically and what value those trees provide to both the sales price and rental price of homes. Figure 6, which explored the relationship between median canopy cover and the Likert statement asking residents whether or not they agreed that trees influenced their rental/purchase decision, shows that higher rates of canopy cover are associated with those who strongly disagreed with the statement. Despite this, the amount of canopy cover within a respondent's neighborhood did decrease as agreement with the Likert statement diminished. It is also important to note that although the property of respondents who strongly disagreed had the highest rate of canopy cover, it was also one of the lowest reported responses for this particular statement; the majority of responses to this question strongly agreed/agreed with the statement. Although there is not distinct relationship between canopy cover and purchase decision, it is possible that with a larger sample the slight trend seen in neighborhood canopy cover would be more apparent. Due to these findings the hypothesis is rejected.

Although the sample population was not representative of the ratio of homeowners to renters that is currently seen in Tampa, there was no reported difference between these two groups of respondents in terms of opinions surrounding trees. In contrast with the literature, the study did not find that White/Caucasians had the highest rate of canopy cover on their properties or in their neighborhood. Despite the lack of overall trends for different ethnic groups, it was apparent that Asian/Asian Americans reported more positive opinions of trees while also having the highest rate of canopy cover on their property. While it was expected that residents living in lower valued homes would report more negative opinions of trees, overall the responses were primarily positive. Finally, despite a slight trend for neighborhood canopy to decrease as agreement with tree influencing rental/purchase decision diminished, the highest rates of canopy cover were associated with strong disagreement with this statement. Overall, the sample population reveals that opinions of trees in

Tampa are overwhelmingly positive with acknowledgment of both the benefits associated with trees and the drawbacks associated with trees.

CONCLUSIONS

This study sought to test different factors in relation to how the residents of Tampa perceived and valued trees based off of their opinions. The sample population showed that the opinions surrounding trees were primarily positive. It seems that residents of Tampa value trees mostly for their ability to provide shade and their aesthetic value. Despite a majority of the sample population never experiencing damage to their property from trees, this was one of the highest reported drawbacks. Based on the literature it was expected that renters would have more favorable opinions of trees because they do not bear 100% of the costs and that neighborhood trees would also be more favorable due to the lack of drawbacks for property owners. While homeowners did report more drawbacks compared to renters, it was unclear whether renters had more positive opinions. This was also true for whether or not neighborhood trees were valued more than trees found on respondents' properties. Despite the literature pointing to residents of lower affluence having more negative opinions of trees, this was opposite for the sample population. The literature also suggests that race/ethnicity is a factor in landscape preference and distribution of canopy. The study did not find a strong connection between race/ethnicity, canopy cover, and opinions of trees. Finally, there appeared to be no distinct trend between amount of canopy cover and respondents' agreements that trees influenced their decision to rent/purchase their home.

Limitations and Future Research

Despite the findings of this thesis, it should be noted that there are several limitations that are associated with the methods utilized to gauge residents' perceptions.

- In terms of the possible bias in this study, it is possible that this could be removed by conducting a door to door study to gain a larger variety of opinions. Due to budget constraints this method was not feasible and is also the reason why the sample size was narrowed down to 2000 properties.

- It is also possible that the 20% return rate could have been higher utilizing a multiple contact method to remind residents of the mailed survey but again this was not feasible. To strengthen the outcomes of a study such as this, it is suggested that a door to door method be utilized to broaden the sample population.

- Additionally, a door to door method could allow researchers to gather more useful information on backyard tree canopy that could otherwise not be captured utilizing google street view or satellite imagery.

- Suggestions for future research would be to gather similar information on tree benefits and drawbacks after a severe storm has taken place to better understand the correlation between damage due to trees and perceptions of trees.

- Communicating the environmental, social, and economic benefits to residents might also be beneficial as it seems that many respondents only recognized the benefits when presented to them.

REFERENCES

Alamenciak, T. June 2014. Toronto's trees continue to suffer ice storm damage. Retrieved from https://www.thestar.com/news/gta/2014/06/18/torontos_trees_continue_to_suffer_ice_storm_damage.html

Anderson, L. M., & Cordell, H. K. (1988). Influence of trees on residential property values in Athens, Georgia (U.S.A.): A survey based on actual sales prices. Landscape and Urban Planning, 15(1-2): p. 153-164.

Avolio, M.; Gillespie, T.; McCarthy, H. 2015. Understanding preferences for tree attributes: the relative effects of socio-economic and local environmental factors. Urban Ecosyst. 18: p. 73-86

City of Tampa: Demographics. (2015). Retrieved From http://www.hillsborough.communityatlas.usf.edu/demographics/?ID=1205771000

Conway, Tenley.; Yip, Vivian. 2016. Assessing residents' reactions to urban forest disservices: A case study of a major storm event. Landscape and Urban Planning. 153: p. 1-10

Chowdhury, R. et al. 2011. A Multi-Scalar Approach to Theorizing Socio-Ecological Dynamics of Urban Residential Landscapes, Cities and the Environment (CATE), 4: 1–19.

Cui, W.; Caracoglia, L. 2016. Exploring hurricane wind speed along US Atlantic coat in warming climate and effects on predictions of structura; damage and intervention costs. Engineering Sturctures. 22: p. 209-225

Des Rosiers, F., Theriault, M., Kestens, Y., & Villeneuve, P. (2007). Landscaping Attributes and Property Buyers' Profiles: Their Joint Effect on House Prices. Housing Studies, 22(6): p. 945 - 964.

Dobbs, Cynnamon.; Kendal, Dave.; Nitschke, Craig. 2014. Multiple ecosystem services and disservices of the urban forest establishing their connections with landscape structure and sociodemographics. Ecological Indicators. 43: p. 44-55

Donovan, Geoffrey.; Butry, David. 2009. The value of shade: Estimating the effect of urban trees on summertime. Energy and Buildings. 41: p. 662-668

Donovan, Geoffrey.; Butry, David. February 2010. Trees in the city: Valuing street trees in Portland, Oregon. Landscape and Urban Planning. 94(2): p. 77-83

Donovan, Geoffrey.; Butry, David. 2011. The Effect of Urban Trees on the Rental Price of Single-Family Homes in Portland, Oregon. Urban Forestry and Urban Greening. 10: 163-168

Donovan, Geoffrey.; Prestemon, Jeffrey. 2012. The Effect of Trees on Crime in Portland, Oregon. Environment and Behavior. 44(1): p. 3-30

Donovan, Geoffrey.; Butry, David.; Michael, Yvonne.; Prestemon, Jeffrey.; Liebhold, Andrew.; Gatziolis, Demetrios.; Mao, Megan. 2013. The Relationship Between Trees and Human Health: Evidence from the Spread of the Emerald Ash Borer. American Journal of Preventative Medicine. 44(2): p. 139-145

Gomez-Baggethun, Erik.; Barton, David. 2013. Classifying and valuing ecosystem services for urban planning. Ecological Economics. 86: p.235-245

Gorman, J. 2004. Residents' opinions on the value of street trees depending on tree location. Journal of Arboriculture. 30(1): p. 36-44

Grey, G.; Deneke, F.J. 1986. Urban Forestry, 2nd edition, Wiley, New York.

HCPA. (2015). Hillsborough County Parcel Layer as of 11/10/2015 [data file]. Retrieved November 10, 2015, from Hillsborough County Property Appraiser http://www.hcpafl.org/Downloads/Maps-Data

Jim, C.Y.; Chen, W. 2009. Ecosystem services and valuation of urban forests in China. Cities. 26: p. 187-194

Johnston, M. 1996. A brief history of urban forestry in the United States. Arboricultural Journal 20: p. 257–278

Jones, R.; Davis, K.; Bradford, J. 2012. The value of trees: factors influencing homeowner support for protecting local urban trees. Environment and Behavior. 45(5): p. 650-676

Jorgensen, E. 1970. Urban forestry in Canada. In: Proceedings of the 46th International Shade Tree Conference. University of Toronto, Faculty of Forestry, Shade Tree Research Laboratory, Toronto, pp 43a–51a

Jørgenson, E. 1986. Urban forestry in the rear view mirror. Arboric J 10: p. 177–190

Kendal, D.; Dobbs, C.; Lohr, V. 2014. Global patterns of diversity in the urban forest: Is there evidence to support the 10/20/30 rule? Urban Forestry & Urban Greening. 13: p. 411-417

Ko, Y.; Lee, J.H.; McPherson, E.; Roman, L. 2015. Long-term monitoring of Sacramento Shade program trees: Tree survival, growth and energy-saving performance. Landscape and Urban Planning. 143: p. 193-191

Koch, J. 2000. The Origins of Urban Forestry. In Handbook of Urban and Community Forestry in the Northeast. Retrieved from https://books.google.com/books?id=8nHdBwAAQBAJ&pg=PA1&lpg=PA1&dq=urban+forests+in+ancient+times&source=bl&ots=cq1w7dcmHy&sig=7X1NsP2xybuorCkf8aPqge7Fy6Y&hl=en&sa=X&ved=0ahUKEwjrrrvp0YrQAhVW2mMKHfblAa0Q6AEILzAE#v=onepage&q=urban%20forests%20in%20ancient%20times&f=false

Konijnendijk, C.; Nilsson, K.; Randrup, T.; Schipperijn, J. 2005. Urban Forests and Trees: A Reference Book. Retrieved from http://download.springer.com.ezproxy.lib.usf.edu/static/pdf/714/bok%253A978-3-540-27684-5.pdf?originUrl=http%3A%2F%2Flink.springer.com%2Fbook%2F10.1007%2F3-540-27684-X&token2=exp=1478109825~acl=%2Fstatic%2Fpdf%2F714%2Fbok%25253A978-3-540-27684-5.pdf%3ForiginUrl%3Dhttp%253A%252F%252Flink.springer.com%252Fbook%252F10.1007%252F3-540-27684-X*~hmac=e891f1e162ccdfef716ab6e9cc7ca5f5d2537d66257ac1e43fdd777aaec47944

Konijnendijk, C.; Ricard, R.; Kenny, A.; Randrup, T. April 2006. Defining urban forestry- A comparative perspective of North America and Europe. Urban Forestry & Urban Greening. 4(3-4): p. 93-103

Kuehler, E.; Hatahway, J.; Tirpak, A. 2017. Quantifying the benefits of urban forest systems as a component of the green infrastructure stormwater treatment network. Ecohydrology. 10(3)

Kuo, F. E., & Sullivan, W. C. (2001). Environment and crime in the inner city - Does vegetation reduce crime? Environment and Behavior, 33(3): p. 343-367

Kweon, B.-S., Sullivan, W. C., & Wiley, A. R. (1998). Green common spaces and the social integration of inner-city older adults. Environment and Behavior, 30(6): p. 832-858

Landry, Shawn.; Chakraborty, Jayajit. 2009. Street trees and equity: evaluating the spatial distribution of an urban amenity. Environment and Planning A, 41: p. 2651-2670

Landry, S., Northrop, R. J., Andreu, M., & Beck, K. (2014). City of Tampa Urban Forest Management, Monitoring and Policy. Florida Geographer, 45: p. 44-62.

Landry, Shawn M., Northrop, Robert J., Andreu, Michael G., and Rhodes, Carolyn C. 2013. City of Tampa 2011 Urban Forest Analysis: The Structure, Composition, Function and Economic Benefits of Trees and the Urban Forest. Final Report to the City of Tampa, September 2013. City of Tampa, Florida.

Locke, Dexter.; Landry, Shawn.; Grove, Morgan.; Chowdhury, Rinku. 2016. What's scale got to do with it? Modela for urban tree canopy. Journal of Urban Ecology. p:1-16

Lohr, V.; Pearson-Mims, C.; Tarnai, J.; Dillman, D. 2004. How urban residents rate and rank the benefits and problems associated with trees in cities. Journal of Arboriculture. 30(1): p. 28-35

Lyytimäki, J.; Sipilä, M.; Sipila, M. 2009. Hopping on one leg – The challenge of ecosystem disservices for urban green management. Urban For. Urban Gree. 8: p. 309–315

Mansfield, C.; Pattanayak, S.K.; McDow, W.; McDonald, R.; Halpin, P. 2005. Shades of green: measuring the value of urban forests in the housing market. Journal of Forest Economics 11 (3): p. 177–199

Millenium Ecosystem Assessment. 2005. Millenium Ecosystem Assessment. Ecosystems and human well-being:synthesis. Island Press, Washington, DC

Miller, RW. 1997. Urban forestry: planning and managing urban green spaces, 2nd ed. Prentice Hall, New Jersey

Moskell, C.; Allred, S. 2013. Residents' beliefs about responsibility for the stewardship of park trees and street trees in New York City. Landscape and Urban Planning. 120: p. 85-95

Northrop, Robert J.; Beck, Kathy.; Irving, Rob.; Landry, Shawn.; Andreu, Michael. 2013. City of Tampa Urban Forest Management Plan. November 2013. City of Tampa, Florida

Nowak, D.J.; Crane, D.E.; Stevens, J.C. 2006. Air pollution removal by urban trees and shrubs in the United States. Urban Forestry and Urban Greening. 4: p. 115-123

Nowak, D.J.; Noble, M.H.; Sisinni, S.M.; Dwyer, J.F. 2001. Assessing the U.S. urban forest resource. Journal of Forestry. 99(3): p. 37-42

Nowak, D.J.; Hirabayashi, Satoshi.; Bodine, Allison.; Greenfield, Eric. 2014. Tree and Forest Effects on Air Quality and Human Health in the United States. Environmental Pollution. 193: p. 119-129

O'Malley, C.; Piroozfar, P.; Farr, E.; Pomponi, F. 2015. Urban Heat Island (UHI) mitigating strategies: A case-based comparative analysis. Sustainable Cities and Society. 19: p. 222-235

Pandit, Ram.; Polyakov, Maksym.; Tapsuwan, Sorada.; Moran, Timothy. February 2013.The effect of street trees on property value in Perth, Western Australia. Landscape and Urban Planning. 110: p. 134-142

Peckham, S. C., Duinker, P. N., & Ordóñez, C. (2013). Urban forest values in Canada: Views of citizens in Calgary and Halifax. Urban Forestry & Urban Greening, 12(2): p. 154-162

Perkins, H. A., Heynen, N., & Wilson, J. (2004). Inequitable access to urban reforestation: the impact of urban political economy on housing tenure and urban forests. Cities, 21(4): p. 291-299.

Pham, Thi-Thanh-Hien.; Apparicio, Philippe.; Ladry, Shawn.; Sequin, Anne-Marie.; Gagnon, Martin. 2013. Predictors of the distribution of street and backyard vegetation in Montreal, Canada. Urban Forestry & Urban Greening. 12: p. 18-27

Sander, H.; Polasky, S.; Haight, R. 2010. The value of urban tree cover: A hedonic property price model in ramsey and Dakota Counties, Minnesota, USA. Ecological Economics. 69: p. 1646-1656

Simpson, J.; McPherson,G. 1996. Potential of tree shade for reducing residential energy use in California. Journal of Arboriculture. 22(1): p. 10-18

Thorsnes, P. 2002. The value of a suburban forest preserve: estimates from sales of vacant residential building lots. Land Economics 78 (3): p. 426–441

Troy, Austin.; Grove, J. Morgan.; O'Neil-Dunne, Jarlath. 2012. The Relationship between Tree Canopy and Crime Rates Across an Urban-Rural Gradient in the Greater Baltimore Region. Landscape and Urban Planning. P. 1-9

Wang, H.; Qureshi, S.; Knapp, S.; Friedman, C.; Hubacek, K. October 2015. A basic assessment of residential plant diversity and its ecosystem services and disservices in Beijing, China. Applied Geography. 64: p. 121-131

Zahmatkesh, Z.; Karamouz, M.; Gogarian, E.; Burian, S. 2015. Analysis of the effect of climate change on urban water runoff using statistically downscaled precipitation data and a change factor approach. Journal of Hydrologic Engineering. 20(7)

Zhang, Y.; Hussain, A.; Deng, J.; Letson, N. 2007. Public attitudes toward urban trees and supporting tree programs. Environment and Behavior. 39(6): p. 797-814

APPENDICES

Appendix A: Resident Opinions of Trees

USF
UNIVERSITY OF
SOUTH FLORIDA

Resident Opinions of Trees
Thank you for taking the time to complete our survey on resident opinions concerning trees on housing properties. Please complete as much of the survey as possible and return in the envelope provided. The definition of a tree is provided below in order to erase confusion between trees and various types of vegetation.
Definition: In this survey we define a **tree** as a woody perennial plant, having <u>trunk greater than 4 inches in diameter</u>.

Part 1: Tree Benefits and Drawbacks
1. Using the above definition of a tree, what are the top 2-3 benefits or positive qualities that you associate with trees:
_____
_____
_____

2. What are the top 2-3 drawbacks or negative qualities that you associate with trees:
_____
_____
_____

Part 2: Opinions about trees in your neighborhood
Please indicate how strongly you agree or disagree with the following statements.

	Strongly Agree	Agree	Neither Agree or Disagree	Disagree	Strongly Disagree
Trees combat the effects global warming.					
Trees increase the value of the property on which I reside.					
Trees help stabilize the soil and prevent erosion.					
Ideally, I would like to live in a neighborhood with large trees.					
Ideally, I would like live in a neighborhood with a tree in front of most houses.					
Neighborhoods with trees are					

more attractive than those without trees.					
	Strongly Agree	Agree	Neither Agree or Disagree	Disagree	Strongly Disagree
Trees provide benefits that I want in my neighborhood.					
Trees create a physical hazard (such as falling branches) I do not like in my neighborhood.					
Trees make a neighborhood look less tidy.					
Trees make a neighborhood less safe (such as blocking views, create hiding places).					
I do not want trees in my neighborhood because they contribute to my allergies.					
I would like my current neighborhood to have more trees.					
Ideally, I would like to see at least one tree when I look out my window.					
Having at least one tree at my home is important to me.					
Trees require more work than they are worth.					
I like the cooling benefits trees provide by shading my house in the summer.					
Trees attract wildlife I like to see in my yard.					
I do not like trees in my yard because their roots cause problems (such as interfering with pipes, cracking sidewalks)					
When purchasing or leasing my home, the presence of trees influenced my decision to live here.					
Trees hinder the view of the road from my home.					
Allergens associated with trees affect the amount of time I spend outside.					

1. Please elaborate on any opinions or experiences you have on trees that are not reflected in the statements above:_____

_____

_____

Part 3: Tree/Outdoor Experience
1. Do you or anyone in your household suffer from allergens associated with trees or other types of vegetation? Yes / No (Circle one)
2. On a scale from 1 to 7 (7 being the highest, 1 being the lowest), how many days would you say you spend outside for an extended period of time (longer than 30 minutes)?
_____
3. When outside, how long do you spend doing the following activities?

	None	0-30 Min	30 Min- 1Hr	More than 1 hour
Gardening				
Exercising				
At a park				
Walking a pet				
Around my neighborhood				
Somewhere outside that is not my neighborhood				

4. When outside, do you spend more time in your neighborhood or in other public places such as parks?
_____
5. Have you or anyone you know ever been injured as a result of falling branches or trees? Yes / No (Circle one)

Part 4: Property History
1. Using the definition at the top of the page, how many trees are in your front yard, between your house and the street?
_____
2. Have you either planted or removed trees since purchasing your home? Yes / No (Circle one)
3. Has your home suffered from damage due to falling trees or branches as a result from heavy winds or rain associated with severe weather?   Yes / No (Circle one)

Part 5: Property Information
1. In order to identify your property with information already known about the trees and tree canopy in your neighborhood, we ask that you provide your street address below. Under the legal requirements of the IRB, your personal information will never be shared nor released and the surveys will be destroyed after the legal holding period has expired.

Street Number and Name:

Zip Code: _____

Part 6: Demographic Information
This portion is optional, but it is encouraged in order to strengthen the results of the study.

1. Please indicate the age bracket that you fall within:

Ages 0-21	
Ages 22-35	
Ages 36-45	
Ages 46-55	
Ages 56 and up	

2. Please indicate your gender identity: _____

3. Please indicate your ethnicity in the boxes below:

White/Caucasian	
Hispanic/Latino	
Black/African American	
Asian/Asian American	
Native American/ American Indian	
Other -> Please List	

4. Please indicate the number of children you have: _____

End of Survey

Optional Comments: We are very interested in any your opinions about trees and/or their value. Please use this space (or attach additional paper) to elaborate on answers to the questions asked in this survey or share additional thoughts.

_____

_____

_____

_____

_____

_____

_____

_____

Appendix B: IRB Approval

RESEARCH INTEGRITY AND COMPLIANCE

Institutional Review Boards, FWA No. 00001669

12901 Bruce B. Downs Blvd., MDC035 • Tampa, FL 33612-4799

(813) 974-5638 • FAX (813) 974-7091

11/8/2016

Cody Winter

School of Geosciences Tampa, FL
33612

RE: **Expedited Approval for Initial Review**

IRB#:   Pro00027783

Title: Perceptions Affecting Tree Valuation

Study Approval Period: 11/8/2016 to 11/8/2017

Dear Mr. Winter:

On 11/8/2016, the Institutional Review Board (IRB) reviewed and **APPROVED** the above application and all documents contained within, including those outlined below.

Approved Item(s):
Protocol Document(s):
IRB Protocol.docx

Consent/Assent Document(s)*:
Informed Consent.docx **

*Please use only the official IRB stamped informed consent/assent document(s) found under the "Attachments" tab. Please note, these consent/assent document(s) are only valid during the approval period indicated at the top of the form(s). ****Survey consent not stamped**

It was the determination of the IRB that your study qualified for expedited review which includes activities that (1) present no more than minimal risk to human subjects, and (2) involve only procedures listed in one or more of the categories outlined below. The IRB may review research through the expedited review procedure authorized by 45CFR46.110 and 21 CFR 56.110. The research proposed in this study is categorized under the following expedited review category:

(7) Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

Your study qualifies for a waiver of the requirements for the documentation of informed consent for this surrvey as outlined in the federal regulations at 45CFR46.117(c) which states that an IRB may waive the requirement for the investigator to obtain a signed consent form for some or all subjects if it finds either: (1) That the only record linking the subject and the research would be the consent document and the principal risk would be potential harm resulting from a breach of confidentiality. Each subject will be asked whether the subject wants documentation linking the subject with the research, and the subject's wishes will govern; or (2) That the research presents no more than minimal risk of harm to subjects and involves no procedures for which written consent is normally required outside of the research context.

As the principal investigator of this study, it is your responsibility to conduct this study in accordance with IRB policies and procedures and as approved by the IRB. Any changes to the approved research must be submitted to the IRB for review and approval via an amendment. Additionally, all unanticipated problems must be reported to the USF IRB within five (5) calendar days.

We appreciate your dedication to the ethical conduct of human subject research at the University of South Florida and your continued commitment to human research protections. If you have any questions regarding this matter, please call 813-974-5638.

Sincerely,

John A Schinka, Ph.D.

John Schinka, Ph.D., Chairperson

USF Institutional Review Board