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A Contingent Valuation of Tampa's Urban Forest Resource

Alec Foster
University of South Florida

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by

Alec Foster

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Major Professor: Graham Tobin, Ph.D.
Kevin Archer, Ph.D.
Steven Reader, Ph.D.

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Keywords: Community Trees, Environmental Benefits, Environmental Economics,
Tailored Design, Stated Preferences

DEDICATION

I dedicate this proposal to all who have helped me along the way. First and foremost my advisor, Dr. Graham Tobin, along with the rest of my committee, Dr. Archer and Reader. I would like to thank Shawn Landry for providing a great deal of information on urban forests and research methods in general. All of my professors at the University of South Florida and during my undergraduate experience at New College of Florida have helped me to become a researcher with the potential to undertake a project such as this. My graduate student colleagues in the Department of Geography have provided a great deal of support and knowledge throughout the years.

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ABSTRACT:

Urban forests provide environmental, social, and economic benefits to urban residents. These benefits are often overlooked when making spatial and financial distributive decisions in urban areas. The City of Tampa has demonstrated interest in its urban forest resource and estimated its extent and some of the benefits provided. Estimating economic values for benefits that have not been quantified can help to ensure that resources are distributed more efficiently. Five methods to estimate urban forest benefits in the City of Tampa are reviewed, with contingent valuation being the method chosen out of this review process. A mailed, dichotomous choice contingent valuation survey was executed with two points of contact, yielding 107 responses for a 21.4 percent response rate. Despite positively rating the City's urban forest, the majority of respondents (62.6 percent) were willing to pay for it to increase. The Turnbull distribution-free estimator was used to estimate a lower bound of $3.23 for willingness to pay to increase Tampa's urban forest resource by 250,000 trees. Willingness to pay was positively associated with income and education. The survey responses also yielded important attitudinal and behavioral information that can help local decision makers increase the efficiency of urban forest distribution, maintenance, and promotion.

Keywords: Community Trees, Environmental Benefits, Environmental Economics, Tailored Design, Stated Preferences

CHAPTER ONE:

URBAN FORESTS

Introduction

Urban areas are becoming more and more an area of focus in both the social and natural science disciplines, and with good reason. Humanity is rapidly urbanizing, with the percentage living in cities expected to reach 60 percent by 2030 (Bolund and Hunhammar, 1999). With an increasing percentage of humanity living in urban areas, recently estimated at eighty percent of the population of the United States (Lohr et al., 2005), it grows increasingly important to assure that these areas are healthy environments that allow humans to live and prosper. A major factor in a city's healthiness and livability that has been neglected in the past but is growing as a research interest is urban forests (Jensen et al., 2004; Chen and Jim, 2008). This might be reflected in the drafting by Canada of a national urban forest plan (Konijnendijk, 2006). Urban forests provide aesthetic, economic, and environmental benefits to urban residents and visitors. Unfortunately, the rapid expansion of urban areas is putting a great stress on the urban forest resource, as more and more land is claimed for development (Chen et al., 2006; Chen and Jim, 2008). Measuring the extent and benefits of urban forests is the first

step in maintaining or increasing these benefits for the rapidly expanding urban population (McPherson et al., 2005; Chen and Jim, 2008).

The City of Tampa has a rich urban forest resource (Andreau et al., 2008). The City's interest in this resource is evidenced by its commissioning of regular ecological analyses of this resource, the most recent of which was completed and presented to the City in 2008 (Andreau et al., 2008). These analyses have quantified the urban forest resource economically, in dollar terms, as well as ecologically. While the benefits estimated by these studies are great starting points and should be used to provide insight to policymakers in the planning process, there are some economic benefits of Tampa's urban forest resource whose quantification is beyond their scope. These benefits are discussed briefly in the literature review, before moving on to different methodologies for their estimation. These methodologies include the standard environmental economics techniques of contingent valuation, the hedonic price method, and the travel cost method as well as relatively new and novel methodologies specific to urban forests that attempt to measure the benefits of stormwater retention (Ziao and McPherson, 2002; McPherson et al., 2005) and increased consumer preferences for downtown business districts (Wolf, 2005, 2004). The theoretical underpinnings of each methodology are discussed in detail before summaries of their applications to urban forest benefits are presented.

The conclusion drawn from this process is that the contingent valuation methodology is the best tool to use for a complete estimation of the benefits provided by the City of Tampa's urban forest resource. All of the valuation methods are acknowledged to have their advantages and disadvantages, and different methods may be appropriate for different resources, locations, and research budgets (Hoevenagel, 1994b).

Contingent valuation was chosen because it can be applied at the correct spatial scale to estimate a value for the entire urban forest resource of a city (Chen et al., 2006; Treiman and Gartner, 2006). The travel cost and hedonic price methodologies are typically applied to one or several forested areas or forested parks in a city when used to estimate urban forest benefits, and the use of these methodologies to value the entire urban forest resource of a city would be incredibly cumbersome if not impossible. Another advantage of the contingent valuation methodology is that it is independent of an existing data set, allowing for more flexibility (Hoevenagel, 1994b). Contingent valuation is also the only methodology of those discussed that can be used to measure non-use value (Mitchell and Carson, 1989; Boyle, 2003), or benefits derived by those who do not actually use an environmental resource (Krutilla, 1967). This comprehensiveness of the contingent valuation methodology that other methods lack is one of the reasons that it has become the most popular method for valuing non-marketed environmental goods (Hoevenagel, 1994b).

After contingent valuation is established as the tool that will be used to estimate the monetary value of the City of Tampa's urban forest resource, a methodological structure is constructed to achieve this estimate. Although contingent valuation was first proposed by Ciriacy-Wantrup in 1947 (Smith, 1993) and has been applied extensively over the last thirty years, various methodological techniques have been applied to different facets of the estimation process, and there is a lack of a single accepted method for conducting a contingent valuation study (Boyle, 2003; Whitehead, 2006). The guidelines proposed by the National Oceanic and Atmospheric Administration (NOAA) in 1993 (NOAA, 1993) for using contingent valuation in natural resource damage

recovery estimates are adapted for this study using the vast wealth of theoretical and methodological work done in the field before and after their construction. All aspects of the study, including: survey design, sampling, pilot testing, survey execution, data analysis, and reporting are laid out in this methodology.

The willingness to pay data obtained from the contingent valuation study will be examined along with other data collected to obtain further information about the preferences of Tampa residents towards their urban forest resource. These other data will include the forest cover map constructed by the Urban Ecological Study (Andreau et al., 2008) as well as demographic data from the United States Census and the City of Tampa Property Appraiser. Forest cover and demographic characteristics will be compared at the correct spatial increment to willingness to pay values in an attempt to validate the contingent valuation portion of the study as well as construct a richer portrait of urban forest preferences.

Literature Review

Introduction

Urban forests are a valuable asset to any urban environment. They provide a wide range of benefits to citizens and visitors. These benefits can play a great part in improving quality of life in urban areas and help to stabilize urban ecosystems (Chen and Jim, 2008; Bolund and Hunhammar, 1999; Kielbaso, 2008). Unfortunately these benefits are often not considered when planning decisions affecting the distribution of urban

forest resources are made (Dwyer et al., 1992). While the pressures of growth and development may play a large part of this lack of consideration of the important benefits conferred by urban forests, another important factor is the lack of value assessments made for these environmental, social, and health benefits. If estimations are established for the benefits provided by the urban forest resources of a city, they can then be considered when making these decisions. This can result in a more efficient distribution of these resources.

The City of Tampa completed its most recent urban ecological analysis in 2006-2007 (Andreu et al., 2008). This analysis measured Tampa's existing urban forest while also examining the change in the urban forest resource over time using historical data and previous urban ecological analyses. Many benefits of Tampa's urban forest were quantified in dollar amounts. These benefits included: energy conservation, air pollution removal, carbon storage and sequestration, and compensatory value (Andreu et al., 2008). These monetary values of the urban forest produced by these studies are a great starting point and can provide policymakers with an idea of the value of the urban forest resource when considering decisions affecting land use.

Urban forests can ameliorate the urban heat island effect (Sampson, 1989; Chen and Jim, 2008; Kielbaso, 2008; Bolund and Hunhammar, 1999; Heidt and Neef, 2008; Sailor, 1995). Urban areas have been shown to be 0.5 to 1.5 degrees Celsius warmer than surrounding areas in temperate climates, and up to 3.0 degrees C warmer in tropical areas (Chen and Jim, 2008). The urban heat island effect is caused by many characteristics or urban areas, including: lower albedo, high thermal capacities and low insulating abilities of building materials, and a lack of vegetative materials (Chen and Jim, 2008). These

increased temperatures in urban areas can cause stress, physical discomfort, and even death for urban residents (Heidt and Neef, 2008). There are three different ways that urban forests can help to ameliorate the urban heat island effect. The first of these is trees shading buildings and preventing solar radiation from striking them. This results in a reduction of initial heating and storage and a lower amount of energy necessary to cool buildings (Chen and Jim, 2008). Secondly, urban forests can lower summer ambient air temperatures through increased evapotranspiration. Transpired water from leaf surfaces of urban forests cools the air because latent heat of vaporization from the ambient air is absorbed to convert liquid water at the leaf surface into water vapor in the air (Chen and Jim, 2008). An urban area with good forest cover can have a noticeably decreased air temperature where people feel more comfortable and less energy is used for air conditioning due to evapotranspiration (Chen and Jim, 2008). Thirdly, urban forests can act as windbreaks by increasing surface roughness in urban areas. This reduction in wind speed reduces the penetration of outer air into indoor spaces, reducing the need for cooling in the summer and heating in the winter (Chen and Jim, 2008).

A benefit closely linked to the amelioration of urban heat islands is the part urban forests can play in energy conservation by reducing the need to heat or cool buildings (Andreau et al., 2008; Chen and Jim, 2008; Kielbaso, 2008; Dwyer et al., 1992; Ebenreck, 1989; Sailor, 1995). Energy conservation results in cost savings, reductions in the amount of carbon emitted into the atmosphere, and decreases the demand for fossil fuels, a non-renewable resource. Trees near buildings can provide shade that reduces building temperature and the amount of energy needed to cool them. Studies have shown that tree plantings can pay for themselves in 1-3 years in energy reductions alone if

planned properly, one of the fastest payback rates for energy conservation investments (Kielbaso, 2008). This is especially a concern in Tampa, given the high summer temperatures and lack of a cold winter season. The latest Urban Ecological Analysis calculated that for residential buildings only, trees provided over four million dollars worth of energy conservation and the avoidance of carbon emissions was worth over one hundred thousand dollars, for a total of approximately $4.2 million dollars saved in energy conservation for the city's residents due to trees (Andreau et al., 2008). Studies conducted in 2000 through 2002 estimated the annual value of energy conservation provided by urban forests in Baton Rouge, Sacramento, and Salt Lake City at $6.3 million, $12.8 million, and $1.5 million, respectively (Chen and Jim, 2008).

Urban forests can also reduce the presence of atmospheric pollutants in cities (Nowak et al., 2006; Bolund and Hunhammar, 1999; Dwyer et al., 1992). Air pollution is a problem in urban areas because it poses a great risk to human health and can cause other problems such as damage to vegetation and materials made by humans, visibility reduction, and acid deposition (Chen and Jim, 2008). Levels of air pollution in cities can be anywhere from five to twenty-five times higher than that in surrounding rural areas (Heidt and Neef, 2008). These harmful pollutants are removed by urban forests through uptake by their leaves and other surface areas (Andreau et al., 2008; Jim and Chen, 2008; Kielbaso, 2008). The rate of uptake is determined by forest structure and composition (Dwyer et al., 1992). Pollutants eliminated included carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), and sulfur dioxide (SO_2) (Andreau et al., 2008). It was calculated as part of the Urban Ecological Analysis that trees in Tampa removed 1,360 ton of pollution, valued at $6.3 million dollars (Andreau et al., 2008). This does not

include the decrease in healthcare costs due to the air quality improvements provided by the urban forest in Tampa. Another possible saving is a reduction in the significant amounts spent to reduce urban air pollution through other measures (Dwyer et al., 1992). Further air quality improvement is brought about by the temperature reductions due to urban forests mentioned previously, as smog-causing ozone concentrations increase with ambient air temperatures (Dwyer et al., 1992; Kielbaso, 2008; Heidt and Neef, 2008). The emissions of hydrocarbons also increase as temperatures increase (Sailor, 1995). The total amount of air pollution removal by urban trees in the United States was measured at 711,000 metric tons in 2006, with an estimated value of 3.8 billion dollars (Nowak et al., 2006). This improvement in air quality is another valuable benefit provided by urban forests, one that could be increased if the provision of urban forest resources were to increase.

Carbon storage and sequestration is another important benefit provided by urban forests (Chen and Jim, 2008; Kielbaso, 2008; Andreau et al., 2008; Dwyer et al., 1992; Sampson, 1989). Trees store carbon and sequester it during their growth (Chen and Jim, 2008). The reduction in energy demand discussed previously also reduces carbon emissions, as it reduces the amount of electricity necessary to cool urban areas (Jim and Chen, 2008). Both the State of Florida and the City of Tampa have emphasized the importance of reducing greenhouse gas emissions (Andreau et al., 2008). The UEA estimated that trees in Tampa sequestered 511,141 tons of carbon with a conservative value estimate of 10.4 million dollars (Andreau et al., 2008). In 1992, it was estimated that urban forests in the United States stored approximately 800 million tons of carbon, which was estimated as five percent of the total carbon storage by trees in the United

States (Dwyer et al., 1992). Carbon sequestration was estimated at 46,525 tons in 2007 with a conservatively estimated value of $945,396 (Andreau et al., 2008). It has been estimated that urban carbon emissions could be reduced by 0.2 percent to 3.8 percent at 11 percent tree cover and 3.2 to 3.9 percent at 33 percent tree cover (Chen and Jim, 2008). Given the great concern over global climate change both internationally and locally (State of Florida, myfloridaclimate.com), the reduction of atmospheric carbon is a very important function performed by Tampa's urban forest. The State of California has proposed the planting of five million trees in urban areas as part of their plan to mitigate climate change (California Environmental Protection Agency, 2007).

The UEA also estimated the compensatory value of Tampa's urban forest. This valuation is an estimate of the cost of replacing a tree if it were removed, also known as its structural value (Nowak et al., 2002). This value is often used in litigation to determine monetary settlements in insurance claims, loss of property value for income tax deductions, and real estate settlements (Nowak et al., 2002). It was estimated that the total compensatory value for Tampa's urban forest resource was $1.47 billion dollars in 2007 (Andreau et al., 2008). Nowak et al. (2002) estimated the total compensatory value of urban trees in the contiguous Unites States as $2.4 trillion (Nowak et al., 2002). This structural value of trees is another important benefit that should be considered when formulating policy.

Several benefits of Tampa's urban forest remain to be monetized. These benefits include: increased property values, storm water control and sanitation, benefits of increased consumer preferences for forested business districts, noise reduction, recreational benefits, and aesthetic benefits. Quantifying these benefits in monetary terms

will help provide full information to decision makers and allow for a fuller benefit-cost analysis regarding urban forestry issues in Tampa. Urban forests and ecosystems are traditionally neglected in cost-benefit analyses, which might have different results if this were not the case (Bolund and Hunhammar, 1999).

Urban forests can increase property values, whether it is through proximity to an urban forested park (Tyrvainen, 1997; Tyrvainen and Miettinen, 2000; Thorsnes, 2002; Konijnendijk, 2006; Troy and Grove, 2008), or the presence of trees in yards or residences (Anderson and Cordell, 1985). Unfortunately these studies have only estimated values for residential properties, but commercial and industrial properties also gain value when trees are added to their landscaping (Dwyer et al., 1992). A benefit for municipal governments is the increased tax revenue that this urban forest benefit creates. Measurement of this benefit is estimated through the revealed preference method of hedonic valuation, which is discussed in greater detail in the literature review. Different estimations produced over the years have shown that trees contribute from 5-15 percent of the value of a residential property (Kielbaso, 2008).

Urban forests can help to reduce high noise levels in urban areas (Chen and Jim, 2008; Bolund and Hunhammar, 1999; Dwyer et al., 1992; Ebenreck, 1989). Urban areas generally contain high noise levels that can cause physical and psychological stress to human beings (Chen and Jim, 2008). High frequencies can be absorbed, deflected, or refracted by urban forests with the proper design (Chen and Jim, 2008). Unwanted sounds can also be masked by urban forests as tree leaves move in the wind or birds or other animals make pleasant noises in tree canopies (Chen and Jim, 2008). This is an

important urban forest benefit, as the overall costs of urban noise were estimated to be between .02-2 percent of GDP in Europe in 1998 (Bolund and Hunhammar, 1999).

Urban forests can help to reduce the costs for storm water retention in urban areas (Chen and Jim, 2008; Xiao and McPherson, 2003; Kielbaso, 2008; Bolund and Hunhammar, 1999; Dwyer et al., 1992; Ebenreck, 1989). These benefits and their quantification are discussed further in the literature review, but a brief outline of the value provided by urban forests is presented here. Urban areas have a far greater percentage of impermeable surfaces such as roads and buildings that modify the hydrological cycle in cities. This results in a reduction in rainfall interception and evaporation of intercepted waterfall. A majority of rainfall has to run off from these impermeable sources, necessitating large investments in storm water drainage systems in urban areas (Chen and Jim, 2008). It has been estimated that in vegetated areas only 5-15 percent of rainwater runs off the ground, compared to up to 60 percent in cities lacking in vegetation (Bolund and Hunhammar, 1999). Urban forests can help to reduce the high cost born by urban areas for storm water retention. A five city study conducted by McPherson et al. (2005) quantified the annual benefits of storm water retention and other services provided by urban forests. Bismarck had the highest benefits, at $496,227. This was attributed to the high interception rate as well as the high cost of detention/retention in that city (McPherson et al., 2005). Ft. Collins, Cheyenne, Berkeley, and Glendale had storm water runoff reduction benefits of $403,597, $55,297, $215,648, and $37,298, respectively.

Urban forests also provide physical and psychological health benefits to urban residents. Urban forests can be islands of calm and serenity in otherwise frenetic urban

environments (Chen and Jim, 2008; Heidt and Neef, 2008; Dwyer et al., 1992). Researchers have also found evidence of therapeutic values supplied by urban forests (Chen and Jim, 2008; Ulrich, 1984; Velarde et al., 2007; Ebenreck, 1989). The most famous such study was conducted by Ulrich (1984), where he found that cholecsystemectomy patients in suburban Pennsylvania who had a view of trees recovered faster than those who had a view of only walls and buildings, all else being held equal (Ulrich, 1984). More than 30 peer-reviewed studies have found that view of or exposure to "nature" in urban environments provided positive health effects, with over half of those studies being focused on views of trees (Velarde et al., 2007). Contact with nature has also been shown to have a positive effect on children with attention deficit disorder (ADD) (Andreau et al., 2008). Urban forests have also been found to reduce levels of aggression and crime in areas where they are present (Velarde et al., 2007; Kuo and Sullivan, 2001).

Recreational benefits are also provided by urban forests. These might be the most easily understood and appreciated urban forest benefits (Chen and Jim, 2008). Wooded parks and preserves are extremely popular amenities that allow the surrounding bustle of the city to be forgotten while they are enjoyed. Recreational benefits are typically quantified by the revealed preference travel cost method, where the cost of travelling to a site is used as a proxy for its cost where there is not an entrance fee. Unfortunately this method is not the most appropriate for valuing urban forests, as transportation costs are often minimal within cities, causing the methodology to mostly be applied to remote sites. Another issue is that values for other park amenities than urban forest resources such as ponds, picnic areas, or athletic fields can be included in the estimates garnered.

Despite the difficulties, several studies have used the travel cost method to value forested urban parks (Dwyer et al., 1983; Lockwood and Tracy, 1995). Both of these studies found the recreational values supplied by urban forests to be extensive, and others have hypothesized that recreational benefits might have the greatest monetary value of any urban forest benefit (Chen and Jim, 2008). The travel cost methodology is discussed further in the literature review as a potential tool for estimating the unquantified benefits of Tampa's urban forest.

Measuring these unquantified urban forest benefits in Tampa can be accomplished in several different ways. The methods are fairly straightforward for benefits for which a market exists (Kahn, 1995). Nonmarket goods require the construction of a hypothetical market to estimate their value (Kahn, 1995). Methodologies which use constructed or hypothetical markets include: contingent valuation or willingness to pay, hedonic valuation, and the travel cost method. These methods, as well as those concerning marketed goods will be discussed in the remainder of the literature revue in terms of their application to valuing urban forest benefits.

Willingness to Pay For Urban Forests

Contingent valuation, or willingness to pay (WTP), is one method of measuring the social and aesthetic values of urban forests. The contingent valuation method was first proposed by Ciriacy-Wantrup in 1947 (Smith, 1993).The recreational values of urban forests and forested parks are quantified based on surveys that ask residents how much they would be willing to pay to use these amenities. Another form of contingent valuation

asks the amount that respondents would be willing to pay to preserve or prevent construction in an urban forest or park. Different from the WTP methodology is a strategy that asks respondents how much compensation they would require for the loss of an environmental resource, this is referred to as willingness to accept (WTA) contingent valuation (Kahn, 1995). Due to issues some have taken with WTA methodologies and results (NOAA, 1993), all further discussion of contingent valuation will fall under the framework of WTP. Contingent valuation is a stated preference technique, based on intended rather than actual behavior, as opposed to a revealed preference technique that measures actual behaviors that have not been previously quantified, such as the hedonic pricing method or travel cost method (Konijnendijk et al., 2006). Both of these techniques capture urban forest values that are not quantified otherwise. These values can provide important input into urban land-use planning and decision making. Policy and decision-makers can be enabled to make better choices about potential land use changes when they have more complete information regarding the economic value of these different land use options. Benefits of urban forest resources that have not been previously quantified can be supplied by these studies to aid in this decision making process.

The contingent valuation method is the most widely used method in valuing environmental assets (Tyrvainen, 2001; Carson and Hanemann, 2005). Contingent valuation studies have been conducted in over fifty countries (Veseley, 2007).There are several types of questioning modes for contingent valuation surveys, including dichotomous choice, iterative bidding, open-ended, and payment card. The iterative bidding format that was used in the seminal contingent valuation studies has largely

abandoned recently due to concerns with anchoring effects (Mitchell and Carson, 1989), where the first bid level offered to respondents has a large affect upon their level of willingness to pay. Open-ended questions ask respondents what the maximum amount they would be willing to pay, without suggesting any values. Dichotomous choice questions provide a series of bid amounts to different respondents, asking respondents if they would be willing to pay them and then econometrically unscrambling these results to create a median WTP. It has been argued that the dichotomous choice mode is easier for respondents, as it is similar to an actual voting or purchase decision (Tyrvainen, 2001). One might think that open ended questions would generate overbidding, but it has been shown to provide conservative estimates (Tyrvainen, 2001). The payment card method is a variation of the open ended mode. Respondents are presented with a selection of willingness to pay amounts and asked to choose their maximum amount. Similar to dichotomous choice methods, it has been argued to be less cumbersome to respondents, as it provides visual assistance (Tyrvainen, 2001). None of these questioning techniques has been proven to be vastly superior to another thus far, and the proper questioning technique is also dependent upon the asset undergoing valuation as well as the general survey design (Tyrvainen, 2001).

Three majors concerns have been advanced regarding the contingent valuation method: the existence of imperfect information about the way the environmental resource affects a person's utility, the possibility that the stated value is for a good other than the one being addressed in the survey, and the possibility that there are systematic differences between how much people will pay hypothetically and how much they will pay in a real scenario (Kahn, 1995). All of these concerns have been addressed in the vast body of

contingent valuation literature, and there are methods to avoid or minimize each of their affects.

Imperfect information relates to the fundamental economic assumption that individual economic agents have perfect information about the good in question, and its relation to all other goods. This issue can be addressed by providing adequate information about the resource in question in the contingent valuation survey to approximate the amount of information that would be consistent with a market transaction (Kahn, 1995). This includes a description of the environmental resource in question as well as substitutes, complements and the budgetary constraints of the respondents (Bateman and Mawby, 2004). A detailed description of the change in quantity of the environmental resource whose value is being estimated is essential to the garnering of credible estimates in any contingent valuation study. Without these levels of resource provision being clearly specified, each respondent will have to make inferences and even guesses about the level and quality of resource provision, which will result in different respondents valuing different levels of resource provision (Boyle, 2003). One method of examining the information issue is requiring contingent valuation responses to consist of a satisfactory transaction. A satisfactory transaction is defined as one in which the agent is fully informed, uncoerced, and able to identify and act upon his or her own best interests (Hoevenagel, 1994). All of these components of a satisfactory transaction require respondents to be fully informed in a contingent valuation study. Satisfactory transactions will result in contingent valuation studies that are valid and reliable, suitable for use in planning decisions or cost-benefit analysis. The provision of information and its effects

upon the valuation estimates garnered by this study is discussed in much greater detail in the methodology section.

An example of valuing other goods would be a respondent to a contingent valuation survey who receives utility from participating in the survey and includes this utility in his or her valuation of the resource in question. This is known as the warm glow bias (Mitchell and Carson, 1989). Others respond with a positive value for the good because they believe that it will show that they have more socially desirable or respectable characteristics, even if they have no value for the resource in question (Leggett et al., 2003). This is known as social desirability bias (Leggett et al., 2003). It is believed that this bias is a greater issue to contend with when using in-person interviews, as the presence of an interviewer will cause the respondents to temper their responses towards what they feel are socially desirable responses that will cause the interviewer to hold them in higher esteem (Leggett et al., 2003). This bias can also be present in any other type of survey, as there is no complete assurance of anonymity available to respondents. Attempts have been made to compare the level of this bias between different modes of survey execution, but difficulties exist in holding all other factors constant (such as the sampling frame or other context effects) other than the two modes of administration (Leggett et al., 2003). Despite these difficulties, several studies have shown that the presence of interviewers contributes greater to the presence of social desirability bias than other modes of survey administration (Leggett et al., 2003; Schuman, 1996).

Another type of response that values other goods is known as protest bidding (Lindsey, 1994). In a protest bid, a respondent who has value for the resource in question

signifies that they do not have any value, i.e., that they would not be willing to pay. This can occur when the respondent rejects an aspect of the hypothetical scenario, such as the payment vehicle. Some people are opposed to all new taxes, even for environmental goods for which they hold utility, others believe that is the job of industry rather than government to deal with environmental issues, others believe that it is unethical to place a monetary value on environmental goods, and there are other reasons that can generate protest bids. Another type of zero protest bid is the classic economical concept of "free riding" (Mitchell and Carson, 1989). This occurs when a respondent holds a value for the environmental resource in question, but responds with a zero valuation, believing or hoping that others will pay for it and they will be able to enjoy the resource provision without having to pay for it. It is believed that these issues can be avoided through properly written surveys (Kahn, 1995). There are also question types that can be used to identify protest responses that have been recommended by most of the major methodological treatises in the contingent valuation literature (Mitchell and Carson, 1989; NOAA, 1993; Boyle, 2003). The design of these questions and the treatment in data analysis of any protest bids that occur despite attempts to prevent them are discussed in greater detail in the methodology.

The last major issue regarding contingent valuation is the possibility of inherent differences between hypothetical and actual responses, known as hypothetical bias (Mitchell and Carson, 1989). This is one of the major critiques leveled against the contingent valuation method, summarized by a comment made by an early reviewer of the method "ask a hypothetical question and you get a hypothetical answer (Boyle, 2003, p. 11)." This bias can be caused by the lack of complete information, the warm glow

effect or social desirability bias, and protest bids as well as other factors. One of these other factors that can cause a difference between real and hypothetical valuations is strategic behavior, another type of protest bid. This is when a respondent replies with a higher or lower value than that which they actually hold for the environmental resource in question in an attempt to influence the outcome of the hypothetical scenario in the valuation exercise (Mitchell and Carson, 1989; Harrison, 2007). For strategic behavior to be present, respondents need to realize its possibility, be willing to use it, and think that its use can have an effect on the process outcome (Hoevenagel, 1994). One way to approach this concern is to use conservative models and estimates (Lindsey et al., 1995). Another method that has been developed to deal with this potential source of bias in contingent valuation studies is the "cheap talk" design that actually informs respondents what hypothetical bias is and cautions them to avoid it (Cummings and Taylor, 1999; Veisten and Navrud, 2006). Another method involves increasing the survey's level of incentive compatibility. This is done by increasing the respondent's perceptions of the consequences of their response to the valuation question and the survey as a whole (Harrison, 2007). Respondents will be less likely to inflate or deflate the values that they are attributing to an environmental resource if they believe that those values will actually have an impact and that they may one day actually have to pay what they have expressed as their willingness to pay. Using the referendum style dichotomous choice question format has been put forth as a method to increase incentive compatibility and reduce or eliminate hypothetical bias (Whitehead and Blomquist, 2006). These possible sources of biases, or systematic sources of error, are discussed further in the methodology section, where an overarching goal is the minimization or elimination of their presence.

Despite the many concerns expressed by those holding reservations towards the use of contingent valuation (critical books have even been written about the methodology, although the most popular example was sponsored by Exxon when they were concerned about contingent valuation being used for the recovery of natural resource damages in oil spills, including the incorporation of non-use values into these natural resource damage lawsuits see [Hausman, 1993]), it remains the most popular method of valuing non-marketed environmental goods (Tyrvainen, 2001; Carson and Hanemann, 2005). Details on how all of the concerns discussed previously are being addressed in this study are included in the methodology section.

The National Oceanic and Atmospheric Administration (NOAA) convened a panel of independent economic experts including Nobel Laureates Kenneth Arrow and Robert Solow to evaluate the use of contingent valuation (Lindsey et al., 1995). The panel concluded that contingent valuation methods provided suitable estimates of the valuation of nonmarket environmental goods provided that the studies were constructed well and up to the current standards (Tietenberg, 2000). This external validation of the contingent valuation methodology lends it a previously lacking level of respectability, and allowed for its use in contentious debates about reparation assessments in natural resource damages cases (Carson et al., 1996). One area of contingent valuation that the NOAA Panel dismissed was that constructed around the willingness to accept (WTA) hypothetical scenario (NOAA, 1993). This concern is based upon the concern that unrealistically high values would be attributed in these scenarios (NOAA, 1993; Lindsey, 1994). WTP is by far the most common form of contingent valuation study performed

and was so even before the NOAA Panel published its guidelines in 1993 (NOAA, 1993). Any further discussion of contingent valuation is based upon the WTP methodology.

There have only been a few applications of contingent valuation estimating values of urban forests, while over fifty applications have been conducted for non-urban forest locations (Barrio and Loureiro, 2009). Tyrvainen estimated urban forest values in two medium-sized towns in Finland in 1996 (Tyrvainen, 2001); Dwyer et al. (1989) studied how differing attributes of parks, including the distribution of the urban forest, affected people's willingness to pay to use the parks in Chicago in (Dwyer et al., 1989); Lorenzo et al. estimated the willingness to pay of Mandeville, Louisiana citizens to preserve their urban forest (Lorenzo et al., 2000); Kwak et al. (2003) performed a contingent valuation of Kwanggyo Mountain, a forested area in the Seoul, Korea, metropolitan area (Kwak et al., 2003); Chen et al. (2006) measured the willingness of residents to pay to conserve green spaces in Hangzhou, China (Chen et al., 2006); Treiman and Gartner (2006) measured the willingness of residents to pay for community forests in 44 communities in Missouri (Treiman and Gartner, 2006), and Vesely estimated the WTP of New Zealand residents to prevent a twenty percent reduction in their urban forest resource in 2003 (Vesely, 2007). Further contingent valuation studies of urban forest resources are greatly needed to add to this body of literature and demonstrate the appropriateness of the technique for assessing the value of amenity and other benefits of said resources that have not previously been quantified or included in land use decision making.

Tyrvainen studied two medium sized towns in Finland. Joensuu had a population of 48,000, and Salo contained 23,000 people at the time of the studies. They were chosen because of differences in forested areas; with Joensuu's percentage of green cover within

city limits being almost double that of Salo (Tyrvainen, 2001). The final surveys consisted of four different parts. The first part consisted of instructions, background information on urban forests, and maps of all the areas in question. The second part contained general questions regarding attitudes towards urban forests. The third part of the survey consisted of the WTP questions. Respondents were asked both how much they would be willing to pay to use the parks and recreation areas as well as how much they would be willing to pay to prevent an impending construction project. Both scenarios used the payment card method (Tyrvainen, 2001). The fourth part of the survey collected demographic information. Five hundred surveys were mailed out randomly, yielding response rates of 68 percent and 80 percent for Joensuu and Salo, respectively (Tyrvainen, 2001). The exact numbers of completed surveys for each site are not given by the author.

Both study areas had a high rate of WTP for use of recreation areas, from 64-82 percent in Joensuu and 63-80 percent in Salo, depending on the area in question (Tyrvainen, 2001). The WTP was surveyed monthly in Joensuu and for a two hour visit in Salo, which required calculation of annual recreation values based on use intensities and WTP means. This resulted in an annual WTP value of 25.53 million FIM per year for the six recreation areas studied in the two cities (Tyrvainen, 2001).

The preservation WTP questions resulted in lower values, in Joensuu, the WTP was 45-55 percent, and in Salo it was 48-66 percent (Tyrvainen, 2001). The WTP for the six areas ranged between 1.79 and 0.28 million FIM per year. The aggregate WTP for the six areas was 5.32 million FIM per year (Tyrvainen, 2001). It was found that good location and active management raised the WTP (Tyrvainen, 2001).

Tyrvainen also calculated the costs of maintaining these recreation areas so that they could be compared to the WTP for using them recreationally. The calculated costs included the forest maintenance costs, recreation area costs, and the opportunity costs of not harvesting and selling the timber on the open market. In Joensuu, the calculated benefits were found to outweigh the costs by a factor of seven to twelve, depending upon the area in question (Tyrvainen, 2001). In Salo, the benefits outweighed the costs by a factor of 23 to 26, again depending on the area (Tyrvainen, 2001). The WTP to prevent construction was compared to the price of buying land for the construction project elsewhere. For the one example considered in Salo, residents were willing to pay for a third of the cost of buying land elsewhere to complete the construction project. In Joensuu, they were willing to pay slightly more than the price of buying land elsewhere for the project (Tyrvainen, 2001). While Tyrvainen's study shows a high willingness to pay for urban forest benefits, it is also an example of the necessity to take into account cultural differences when comparing value or perception studies across different cultural groups. The author makes this point explicitly, noting that Scandinavians have a cultural history of living in forested areas and that these values might not be replicated in other cultures where there is not such a high cultural attachment to these resources and therefore there might be a lower social assessment of their benefits (Tyrvainen, 2001).

Dwyer's study is extremely interesting because it separates out park attributes, much like the unbundling of housing attributes attempted in hedonic valuation. The theory behind this is that most WTP studies measure how much users are willing to pay for parks or forested areas as a whole, including other amenities than urban forests such as lakes, streams, picnic tables and areas, bike trails, and other attributes (Dwyer et al.,

1989). The same critique can be applied to most applications of the travel cost method, and complete unbundling of attributes is always a concern in hedonic valuations as well.

The study surveyed 478 park and preserve users in northwest Chicago. 210 park users responded, making the response rate for this study 44 percent (Dwyer et al., 1989). The surveys consisted of 16 pairs of hypothetical park settings that differed based on 22 park attributes that had been found to contribute to park choice. These attributes included terrain, water features, recreation facilities, types of users, amount of users (level of crowding), maintenance, travel time from home, and entry fees (Dwyer et al., 1989). This design was constructed to allow the estimation of the importance of each attribute when choosing a park or recreation area. Because entry fees were one of the attributes that varied across the hypothetical park scenarios, the study was able to estimate the amount that respondents were willing to pay for each attribute (Dwyer et al., 1989).

The results showed that almost all attributes had a positive statistically significant influence on park choice and WTP (Dwyer et al, 1989). With all other attributes remaining the same, respondents were willing to pay up to $1.60 more to visit a park or recreation area that was “mostly wooded, some grassy open areas under trees” (Dwyer et al., p.248), than a park or recreation area with “mowed grass, very few trees anywhere” (Dwyer et al., p.248). Respondents were willing to pay up $0.99 more for “mowed grass, scattered trees, some dense woods” (Dwyer et al., p.248), and up to $0.21 more per visit for “mowed grass, scattered trees, no woods” (Dwyer et al., p.248), than the option with the fewest trees. While there is not an estimation of the total value of forested parkland in Chicago based on these figures, the authors perform an estimate for a single park. The Ned Brown Forest Preserve northwest of Chicago gets more than two and a half million

visits per year, estimating each users willing to pay as $1.00 based on the park's similarity with the $0.99 WTP scenario from the study would value the park's urban forests at two and a half million dollars based on users WTP for the forest amenities (Dwyer et al., 1989).

The study also attempted to determine the park and recreational area preferences of different market segments. There was little success, other than determining that different market segments preferred different types of parks and different quantities and types of forest amenities in parks (Dwyer et al., 1989). One factor of importance for different market segments was the preference for a natural or wild park versus the preference for a maintained, well manicured park. These preferences should be further explored to help in the planning and construction of parks and recreational areas that will best fit the preferences and needs of the corresponding urban areas.

The one suggestion for improvement made by the authors for future similar studies was the use of pictures rather than worded descriptions to better relate stated preferences with actual preferences (Dwyer et al., 1989). While this would increase the costs and timeframe of such a study, there is no question that it would also increase its efficiency.

Lorenzo et al. studied residents' willingness to pay to preserve their urban forest resource in Mandeville, Louisiana, a suburb of New Orleans, in 2000 (Lorenzo et al., 2000). Residents' perceptions were also measured and compared to their WTP, as was a detailed demographic evaluation.

A contingent valuation survey was mailed to 3,009 households in Mandeville, yielding 648 usable responses (Lorenzo et al., 2000). This response rate of 22 percent

makes the study questionable for the legal framework established by the NOAA guidelines, as they call for the rejection of the validity of any study with a low response rate (NOAA, 1993). Fortunately such a legal framework is not the metric by which a study such as this is evaluated and useful information surrounding urban forest preference and values can still be garnered from such a study. Unlike many mail contingent valuation studies, the Dillman Tailored Design Method (Dillman, 2007) was not followed, with only one follow up letter being sent (Lorenzo et al., 2000). This could be the reason for the response rate. Another concern is that the survey respondents are not representative of the population of Mandeville. The youngest age and income brackets are not well represented in the sample population produced by this survey (Lorenzo et al., 2000). These are also the two populations that are the least likely to be willing to pay for urban forest preservation (Lorenzo et al., 2000). This makes it questionable to make generalizations about the City's population from the results of this study, including an aggregation of total WTP in the city for urban forest preservation. Despite these limitations, the information garnered by this contingent valuation study can still prove useful to policymakers in the City of Mandeville.

Lorenzo et al.'s results found that over seventy percent of respondents were willing to pay at least six dollars in additional taxes to preserve their urban forest resource. As expected, willingness to pay increased with income and positive perceptions of the urban forest resource (Lorenzo et al., 2000). Interestingly, females were more willing to pay at lower tax levels than males, and males were more willing to pay than females at higher tax levels (Lorenzo et al., 2000), this may be a result of males earning higher incomes in general. The top two benefits expressed by respondents were:

aesthetic/visual and shade/reduction of energy consumption; the top three negative features of urban forests expressed were: falling limbs, roots clogging sewers, and disease in trees (Lorenzo et al., 2000).

Lorenzo et al.'s study escapes the pitfall of most contingent valuation studies of urban forest by valuing a city's entire urban forest resource rather than simply a forested park or a few forested parks. Unfortunately the low response rate and unrepresentative sample do not allow for aggregation to the city's general population of the information garnered from this study. Addressing these issues by obtaining a higher response rate, a more representative sample, or weighting values obtained from an unrepresentative sample would be the next step in their research to allow for generalization and aggregation.

Kwak, Yoo, and Han (2003) used contingent valuation to estimate the public's value for Kwanggyo Mountain in the Seoul, Korea metropolitan area. This study was performed because Korea developed rapidly from the 1960s onward, with growth-oriented management and development objectives that resulted in large losses of natural and forested areas (Kwak et al., 2003). This development style changed in 2000, with a "planning first" focus taking the place of the previous emphasis on rapid development (Kwak et al., 2003).. Kwak et al.'s study was an attempt to begin to provide values for urban forests so that they could be considered in the planning process.

Kwanggyo Mountain is a small forested area in the Seoul metropolitan area that is home to many plant and animal species and also provides recreational opportunities for residents and visitors. The local government had a proposed development scheme for part of the area stalled for several years because of civic protests (Kwak et al., 2003). This

actual development scenario in place led great credibility and incentive compatibility to the contingent valuation scenario, as most residents were assuredly aware of the proposed development plan that was featured in the scenario. Great care was taken to enhance this existing understanding of the scenario by constructing detailed descriptions of the results of the hypothetical conservation scenario and the results of the proposed development scenario (Kwak et al., 2003). Respondents were also reminded of substitutes for Kwanggyo Mountain as well as their budgetary constraints. The dichotomous choice referendum methodology was used for the valuation question. An increase in the local urban planning tax was used as the payment vehicle for this scenario, as it was felt that this format would be most familiar to respondents (Kwak et al., 2003). Personal interviews were the surveying method used for this contingent valuation study. The authors felt that this method would produce more results, based upon the idea that Koreans would be less familiar to responding to telephone or mail surveys than Europeans or Americans (Kwak et al., 2003). The low expected response rates of mail surveys based upon cultural factors necessitated the use of personal interviews, despite a great increase in cost with this methodology.

Six hundred survey responses were generated in this study. Unfortunately the response rate was not reported for this study. This is a severe fault of an otherwise excellently conducted and reported study, as the NOAA guidelines call for response rate to be reported and question the validity of a study with a low response rate (NOAA, 1993). Interestingly, only 2.3 percent of respondents had been to Kwanggyo Mountain (Kwak et al., 2003). Despite this low use of the urban forest, 21.2 percent of the respondents were willing to pay for its preservation (Kwak et al., 2003). This scenario,

where non-users are more than eight times the proportion of the population of users that are willing to pay suggests that significantly more of the value attributed to Kwanggyo Mountain is based upon non-use rather than use values. Younger people, people who visited forests or the specific forest in question, people already knowledgeable about deforestation, and those with higher incomes all had a higher willingness to pay (Kwak et al., 2003). The average WTP was 1558 won per household (at the time of the survey, approximately 1300 won were equal to one US dollar) (Kwak et al., 2003). Aggregating these estimates to the population level gave a yearly value of 3.77 billion won or 2.9 million US dollars. As the valuation question was asked based on five years of contributions to the conservation program, this would give a total value to the conservation program of Kwanggyo Mountain of 16.3 billion won or US$ 12.54 million over the five year period, assuming a five percent discount rate (Kwak et al., 2003). This shows that a great value was placed upon conservation of this urban forest resource by the residents of the Seoul Metropolitan area. The next step, as suggested by the authors, would be the comparison of this public value with the conservation costs or the cost of using an alternative site for the proposed project.

Chen, Bao and Zhu (2006) studied the willingness to pay of Hangzhou, China residents for green space conservation. Hangzhou is known internationally for its natural beauty and landscapes, with many forested parks and green spaces in the city (Chen et al., 2006). It has received both the China Habitat Prize and the UN Habitat Prize. Recent expansion has led to conversion of some green spaces to other uses and this study was the first step in assessing public support for conservation in Hangzhou. The contingent valuation survey used a payment card method, yielding 600 responses that also collected

information regarding the respondents' general attitudes towards urban green spaces and their demographic information. Similarly to the study performed by Kwak et al. (2003), the surveys were conducted using personal interviews, as it was felt that Hangzhou residents would not be familiar or comfortable with mail or telephone surveys (Chen et al., 2006). A remarkably high response rate of 91 percent was obtained by this study (Chen et al., 2006). This method allowed for an estimation of the total population's WTP as well as analysis of factors affecting this WTP. The mean WTP per household was $24.40, and there were approximately 630,000 households in the city, yielding a total WTP for the city of $15.4 million (Chen et al., 2006). It was found that all positive factors respondents associated with green spaces resulted in higher WTPs, with "aesthetic/visual"; "gives shade, reducing glare and energy consumption", and "provides recreation places" having the highest correlation with WTP (Chen et al., 2006, p.28). It was found that females were more likely to be willing to pay than males, homeowners were more likely to be willing to pay than renters, and that WTP increased with income (Chen et al., 2006).

While Chen et al. did not break out the values of trees from the rest of the amenity values associated with the green spaces as Dwyer's exemplary study did, it is important that they included the effects of demographics associated with different levels of WTP. This is a feature that should be included in further studies, as these differences in WTP can be examined in relation to the use and appreciation of urban forests by demographic groups. It can also help target marketing efforts to expose under appreciative groups to the amenities provided by urban forests. These demographic affects can also serve to help

validate contingent valuation studies if they are correlated with prevailing economic and consumer preference theory.

Treiman and Gartner studied the WTP for improved tree care and maintenance in 44 communities in Missouri (Treiman and Gartner, 2006). This survey was a result of massive underfunding and cutbacks in community forestry programs across the state. A dichotomous choice contingent valuation survey was sent out to residents of 44 communities in Missouri, receiving 6,575 respondents for a response rate of 40 percent. The WTP question was phrased as willingness to pay a tax to be put into a tree fund for improved tree care and maintenance. It is unfortunate that the environmental good being valued was ambiguous in an otherwise excellent study. Different respondents could have different conceptions of the results of money being put into the tree fund, leading them to value different goods. This is why it is very important to clearly define the good being valued to avoid this potential pitfall of contingent valuation (Mitchell and Carson, 1989; Boyle, 2003). Ten strata of town sizes, including St Lois and Kansas City and their suburbs were established to compare WTP across the strata (Treiman and Gartner, 2006). Across all ten strata, respondents were willing to pay for improved tree care and maintenance, with 53 percent overall responding positively to the WTP questions (Treiman and Gartner, 2006). Generally, there was a higher positive response rate as the size of the city being surveyed increased (Treiman and Gartner, 2006). The authors speculate that this may reflect a greater awareness of the need for a tree fund, or a greater willingness to depend on governmental solving of these types of problems (Treiman and Gartner, 2006).

This study also gathered and analyzed the demographic information of respondents. Younger respondents between the ages of 20 and 35 were most likely to be willing to pay for the tree fund, while those over 65 were the least likely to be willing to pay (Treiman and Gartner, 2006). Respondents who had lived at their current address for a shorter amount of time were more likely to be willing to pay than those who had lived there for over 25 years (Treiman and Gartner, 2006). There was no major difference between the WTP of men and women, but the results correlated positively with education and income (Treiman and Gartner, 2006).

Treiman and Gartner's study has some interesting applications. Like Chen et al, the WTP for an entire region's community forest resource is measured. Another similarity is that demographic information is gathered and analyzed. Unfortunately, unlike Chen et al, the WTP is not directly quantified.

Vesely's 2003 contingent valuation study performed in New Zealand overcomes some of the shortcomings of Treiman and Gartner's study. The entire urban forest of New Zealand is estimated, with respondents stating their willingness to pay to prevent a twenty percent reduction in the island nation's urban forest resource. This WTP is also aggregated to provide a total value for the population as a whole. The only drawback to this study is the small sample size of 346, which was used to estimate WTP for the entire country of approximately 4.4 million people.

A self administered survey was delivered door to door, resulting in a response rate of 63 percent and 346 completed surveys (Vesely, 2007). The dichotomous choice method was used, with the typical preference and demographic data being gathered as well as the specific valuation information. The average household was willing to pay

NZD 184 yearly for a three year commitment, which aggregates to NZD 153 million. Those who perceived the loss to be greater, those who belonged to environmental groups, and those with higher incomes were willing to pay more to preserve the twenty percent of their urban forest resource in question. Interestingly, the willingness to volunteer work to prevent the twenty percent loss in urban forest resource was also examined in this survey. Fifty-five percent of those who were not willing to pay were willing to volunteer work to prevent the urban forest loss in question. An interesting extension of this analysis would be to quantify monetarily the value of this time that would be volunteered, as it would provide another estimate of the value assigned to the urban forest resource in question. Another extension of this work would be to measure the amount that residents would be willing to pay to prevent a one hundred percent loss of their urban forest resource. This would allow for the estimation of the total value assigned to the resource. Unfortunately such a survey is not politically feasible, and would also result in a much greater number of protest and warm glow responses.

Willingness to pay, or contingent valuation, is the most widely used method for valuing nonmarketed environmental amenities (Tyrvainen, 2001). Theoretically it measures all of the values of the environmental attribute in question (Tyrvainen, 2001; Mitchell and Carson, 1989). Of course, this requires complete information on all of the environmental, economic, and aesthetical benefits of the resource being quantified. Problems with WTP studies include the fact that the majority of them measure only the value of a specific park or recreational area rather than the value of an urban areas entire urban forest resource. Chen et al, Vesely, and Treiman and Gartner avoid this problem. Another problem is that many WTP studies include the value of other amenities than just

urban forests in parks, recreational areas or greenspaces, the studies of Dwyer et al, Vesely, and Treiman and Gartner avoid this possible problem associated with contingent valuation of urban forests.

Hedonic Valuation

Another valuation method that can be used to capture benefits of urban forests is the hedonic price method (HPM). Another application of the hedonic method, the hedonic wage approach, involves examining wages and attempting to isolate the portion that compensates workers for taking on environmental risks in their profession. This can then be used to devise a willingness to pay to avoid the environmental risk in question (Tietenberg, 2000). Other environmental benefits that have been valued using HPM include: air pollution, scenic views, and quietness (Tyrvainen, 1997). The hedonic price method was first introduced by Rosen in 1974 (Tyrvainen, 1997). HPM estimates the value of environmental benefits through the prices of related market transactions. The most common hedonic application is in the housing market (Tyrvainen and Miettinen, 2000). A house's selling price represents the bundling of all relevant characteristics, such as size, age, number of rooms, and environmental benefits. HPM attempts to unbundle these characteristics and obtain separate values for environmental benefits, such as distance to or a view of urban forests or the presence of trees in the yard. The main advantage of the hedonic method is that as a revealed preference method it uses actual market transactions to obtain values for environmental goods. For this reason some have

evaluated it as a better estimator of values than the hypothetical, stated preference contingent valuation methodology (Hoevenagel, 1994b).

There are several issues with using HPM, including the large numbers of data sets necessary. The functional form of the hedonic equation and multicollinearity among the explanatory values are issues that also need to be addressed (Tyrvainen and Miettinen, 2000). There is such a vast differential within cities of other housing characteristics such as the actual quality of the house; schooling, police, medical and public transport systems; ethnic neighborhoods; congestion; and many other factors that it is also extremely difficult to isolate solely the proximity to urban forest amenities and determine how this effects property values (Kahn 1995; Smith, 1993). Another issue is that the hedonic method only counts the values attributed to urban forests by those who are able to pay for them. Benefits to recreational and other users of the urban forest from housing areas not included in the study are also excluded in hedonic valuations of urban forests (Tyrvainen, 1997).

While air pollution is the most popular environmental attribute valued using hedonic methods (Blomquist and Whitehead, 1995), the hedonic method has also been applied to the valuation of urban forests. Anderson and Cordell's widely referenced 1985 study used the hedonic method to estimate the effect of trees in landscaping on house prices in Athens, Georgia (Anderson and Cordell, 1985). Tyrvainen applied the hedonic method in Joensuu, Finland (Tyrvainen, 1997). Tyrvainen and Miettinen valued the urban forest in Salo, Finland, using the hedonic method and housing prices from the 1980s (Tyrvainen and Miettinen, 2000). Konijnendijk used previous hedonic evaluations for two urban forests in Denmark as part of a multiple use valuation study (Konijnendijk et

al., 2006). Troy and Grove analyzed how crime and parks affect housing prices in Baltimore using hedonic valuation (Troy and Grove, 2008). Jensen et al. used remote sensing to determine how leaf area index (LAI) affected housing prices Terre Haute, IA (Jensen et al., 2004). McPherson et al. studied the benefits and costs of urban forests in five US cities, including hedonic valuation as part of their multi-faceted analysis (McPherson et al., 2005). Thorsnes estimated the value of suburban forest preserves in the Grand Rapids, Michigan metropolitan area in 2002 (Thorsnes, 2002). Jim and Chen used the hedonic method to value green space and other environmental amenities in Guangzhou, China in 2007 (Jim and Chen, 2007). Donovan and Butry used HPM to estimate the values in street trees in Portland, Oregon in 2007 (Donovan and Butry, In Press). An increase in the number of hedonic valuations of urban forests would serve to expand the literature and further demonstrate the methods' validity in assigning values to urban forest resources that can then be used in land use planning processes.

Anderson and Cordell analyzed the effect of trees being present in the landscaping on sales price of houses in Athens, Georgia in 1985 (Anderson and Cordell, 1985). Sales prices were obtained from MLS catalogs covering January 1978 to December 1980. 844 housing sales were analyzed using a hedonic model that contained 44 independent variables attempting to explain a house's selling price. It was found that each tree in the landscaping of a house was associated with a $420 increase in the house's selling price, on average (Anderson and Cordell, 1985). This resulted in a three to five percent increase in selling price for each house with trees present in the landscape, on average (Anderson and Cordell, 1985). The hedonic model constructed was estimated to explain 77 percent of the variation in sales prices, with the other twenty three percent resulting from

unknown housing attributes that affect sales price or sampling error (Anderson and Cordell, 1985). The total increase in selling price of the 844 houses studied associated with the presence of trees in the landscaping ranged between $1.46 and $1.79 million. Given the tax rates in Athens at the time of this study, the increase in sales prices associated with the presence of trees in the landscaping resulted in an additional $20,000 in tax revenue for the city of Athens, using the lower bound estimate obtained (Anderson and Cordell, 1985). The authors estimated that their study covered less than ten percent of the houses in Athens at that time, so aggregating to the city as a whole would result in an estimated $200,000 increase in tax revenue as a lower bound estimate (Anderson and Cordell, 1985). It is not explicated that the houses in the study are representative of the housing population of Athens, so such an aggregation is suspect, yet it can still provide an estimation of the tax value due to increase in residential property values due to landscaping with trees.

Anderson and Cordell's study is different from all of the others studied mentioned except for McPherson et al., in that it estimates the increase in property values associated with trees in residential landscaping rather than the increase in property values associate with a wooded or forested park. McPherson et al. take this a step further and attempt to construct a hedonic model that estimates a value for all of the trees in the five cities in their study (McPherson et al., 2005). The next step for Anderson and Cordell's study, as the authors acknowledge, is the construction of cost benefit estimations using the value estimations that they produced for a segment of the urban forest resource in Athens (Anderson and Cordell, 1985).

Tyrvainen analyzed amenity values of the urban forest resource in Joensuu, Finland using the hedonic price method (Tyrvainen, 1997). Housing data from three years in the 1980s during a stable period in the housing market were used to analyze over one thousand housing sales from 14 different housing areas using eighteen explanatory variables (Tyrvainen, 1997). Characteristics of Joensuu have already been described in the contingent valuation analyses of this City's urban forests.

The results from this study showed that the distance to the nearest wooded recreation area and the relative amount of forested areas in the housing district both had positive effects on housing prices (Tyrvainen, 1997). It was not expected that the distance to the nearest forest park would have a negative effect on housing prices, but the authors suggested that this was based upon the fact that the mature, dense conifer forests of Joensuu might not be desirable at northern latitudes that receive scarce amounts of sunlight in the winter months (Tyrvainen, 1997).

Interestingly, this study was used to examine prospective land changes. One housing district was chosen, and the conversion of the recreation area within it taken into account. This land-use change would increase the average distance to the nearest substitute recreation area by 500 meters (Tyrvainen, 1997). This was estimated to negatively affect housing prices in the area by seven percent (Tyrvainen, 1997). While the prospective analysis is an innovation for hedonic price evaluations, the element lacking in this analysis of Tyrvainen's is an estimate of the total positive effect of the urban forest resource on housing prices in the areas studied.

Tyrvainen and Miettinen performed a hedonic price analysis in Salo, Finland using data on housing sales from 3 years in the mid-1980s (Tyrvainen and Miettinen,

2000). They used over 500 transaction records from terraced houses, which lacked the variability among housing characteristics found in other types of housing in the area (Tyrvainen and Miettinen, 2000). A stable financial period was chosen without major fluctuations in the housing market. Twenty explanatory valuables were chosen, with three of these variables (distance to the nearest wooded recreation area, distance to the nearest forest park, and the relative amount of forested areas in the housing district) measuring urban forest amenities. Characteristics of Salo have already been described in the section on the contingent valuation of the urban forest resource performed in this Finnish City.

It was found that two of the urban forest amenity values had direct positive effects on housing prices in Salo. The first one is distance to a forest park, where an increase of one kilometer in distance from the nearest forested area resulted in a 5.9 percent decrease in selling price, all other variables remaining constant (Tyrvainen and Miettinen, 2000). The second amenity value was a view onto a forest, with a 4.9 percent selling price increase for dwellings with a view of a forest (Tyrvainen and Miettinen, 2000). The value of a hypothetical park of one hectare was also estimated in this study. The total value of forest views was estimated for such a park and added to the estimate of the affect of distance on housing prices. The total value of the park was estimated at 22.82 FIM (3.84 million ECU).

Konijnendijk used HPM surveys conducted earlier for two urban forests in Denmark as part of a multiple use valuation study (Konijnendijk et al., 2006). The HPM surveys were the only benefits quantified monetarily and will be the only valuation technique discussed here. The urban forest amenity was modeled as the distance to the forest edge as a proxy for accessibility to the new forest. As this was a new forest, the

increase in housing values was measured rather than an increase in sales prices as in the analysis of Tyrvainen and Miettenin (2000).

The results found that the implicit price of forest proximity varied greatly with distance to the forest. The shortest distance averaged 100 meters with a price increase of 9.5 percent for the two studies. At six hundred meters the price affect is greatly diminished, with an average increase of 1.5 percent. The first urban forest studied, with an area of 101 hectares, resulted in a gain of 4.662 million Euros for nearby homeowners. The second forest, with an area of 60 hectares, resulted in a gain of 1.243 million Euros for nearby homeowners (Konijnendijk et al., 2006).

Troy and Grove performed a hedonic analysis of property values, parks, and crime in Baltimore using 2004 property value data (Troy and Grove, 2008). Their study attempted to ascertain whether the effect of proximity to parks on housing values was related to park crime levels. Their hypothesis was that park proximity was valued negatively in high crime areas and positively in low crime areas (Troy and Grove, 2008).

The study used 18 explanatory variables, with linear distance to nearest park and combined robbery/rape rate as the two main effects being disaggregated (Troy and Grove, 2008). Robbery and rape were chosen as the crime statistics for the study because they were assumed to be those that would contribute the most to resident's fears of crime in parks and thusly contribute the most to price changes in the housing market. There were approximately 15,600 home sales used in their models. Their definition of a "park" included only those that were over two hectares in size and had 50 percent or more vegetative cover. Four different functional hedonic equations were used to create four models (Troy and Grove, 2008).

The results of the study confirmed Troy and Grove's hypothesis. It was found that when crime rates are relatively low, parks have a positive effect on property values, and when crime rates are high, parks have a negative effect on property values (Troy and Grove, 2008). While proving these relationships between parks, crime, and property values has great potential to effect policy decisions, unfortunately the positive benefits from urban forest amenities of parks were not explicitly quantified in this study. The multicollinearity between parks, crime and property value is also highly likely to vary from city to city depending upon crime rates, perceptions, and park maintenance in each city.

Jensen, Gatrell, Boulton, and Harper used remote sensing in a hedonic study to determine how leaf area index (LAI) affected housing prices in Terre Haute, IA (Jensen, et al., 2004). LAI is the square meters of leaves per square meters of ground. While the study was mostly focused on equity in urban areas and did not quantify the hedonic affect of urban forests on housing values, it is interesting because it looks at LAI rather than proximity to parks. A positive correlation was found between LAI and housing prices (Jensen, et al., 2004).

McPherson, Simpson, Peper, Maco, and Xiao studied the benefits and costs of urban forests in five US cities in 2005 (McPherson et al., 2005). The cities studies were Fort Collins, CO; Cheyenne, WY; Bismarck, ND; Berkeley, CA; and Glendale, AZ. The urban forest benefits quantified were storm water runoff reduction, reduction of energy consumption, atmospheric carbon dioxide reductions, air quality improvements, and aesthetic benefits. A partial quantification of the aesthetic benefits of urban forests in these five cities was accomplished using HPM.

The study used the earlier hedonic valuation performed by Anderson and Cordell in 1985 (Anderson and Cordell, 1985) which found that each large front yard tree increased a house's sales price by 0.88 percent (McPherson et al., 2005). A model was developed with included this value, a depreciated value for park and street trees not in yards, and a variable for LAI was constructed to determine the hedonic affects of urban forests in the five cities. This study is unlike the other hedonic studies in that it actually estimates a value for the entire urban forest resource in each city studied, rather than only a segment, such as an urban forested park or landscaping trees, as in other studies. This allows it to overcome one of the main drawbacks of hedonic studies, the fact that they only examine a small part of an area's urban forest resource. The main fault with this study is that it uses the earlier values estimated by Anderson and Cordell rather than constructing its own hedonic model, as twenty year old estimates for a different city may be outdated or not applicable for changing housing markets.

Other reasons that this study is particularly interesting are both because it compares benefits to costs and because it allows for the comparison of different categories of urban forest amenities. Total annual benefits varied from $665,856 ($31/tree) in Glendale to $3.25 million ($89/tree) in Berkeley. The aesthetic benefits obtained through the hedonic model were the greatest benefits in four of the five cities, ranging from 59-75 percent of total benefits (McPherson et al., 2005). They only accounted for 38 percent of total benefits in Bismarck, but this is explained by the increased proportion of benefits claimed by storm water runoff reduction in that city. This is due to the high percent of interception coupled with the high cost of mitigation in Bismarck (McPherson et al., 2005). The aggregate value of these aesthetic benefits

ranged from $2.5 million in Berkeley to approximately $368,000 in Bismarck. Part of this variation is explained by the median home sales price in Berkeley being five times higher than that in Bismarck (McPherson et al., 2005).

Each city was found to have positive benefits to costs ratios (BCR) for its urban forests. The ratio of benefits to costs was highest in Bismarck, with a return of 3.09 dollars for every dollar spent on urban forests. Berkeley had the lowest BCR at 1.37. Cheyenne, Fort Collins, and Glendale had BCRs of 2.09, 2.18, and 2.41, respectively (McPherson et al., 2005).

Conclusions drawn by this study group emphasize species selection and age. The cities with the highest benefit to cost ratio contained greater amounts of older, larger trees. This results in both lower maintenance costs and higher environmental benefits. Berkeley had the highest total benefits, but the lowest BCR due to the high maintenance cost of its mostly young urban forest (McPherson et al., 2005). The authors acknowledge that their benefit estimates have a range of error not reported, with sources of error including measuring error, modeling error, and random error (McPherson et al., 2005). Despite possibilities for error, this study is a great starting point, in calculating a greater range of benefits and costs in five cities and allowing for comparisons. While the results cannot be generalized to other cities, the methodology can be adapted.

While Thorsnes 2002 study of suburban forest preserves in the Grand Rapids, Michigan metropolitan area values a suburban rather than an urban forest resource, it is noted here due to a new methodological technique for valuing forest resources that offers a possible advancement of the hedonic price method. This is construction of a hedonic model for lot sales as well as housing sales to value the effects of urban forests on real

estate values (Thorsnes, 2002). The idea behind this methodology is that lots are more homogenous than homes, making it easier to construct hedonic equations that capture all of the factors affecting their sales price (Thorsnes, 2002). This reduction in heterogeneity reduces the possibility of error in the hedonic equation, reduces the possibility of multicollinearity problems, and also makes the resulting statistical analysis less difficult. The only problem with this technique is that there need to be enough lot sales to obtain statistically significant results from statistical analysis to estimate the contribution of urban forests to their sales price. Unfortunately this makes the technique more appropriate for suburban rather than urban areas.

Thorsnes analyzed 431 lot sales and 486 house sales from three subdivisions in the Grand Rapids, Michigan metropolitan area. It was found that lots backing onto the forested preserve commanded price premiums attributable to that proximity ranging from $5,800 to $8,400, or 19 to 35 percent of the lots selling price (Thorsnes, 2002). Houses studied that backed onto the forest preserves were found to have a seven percent price premium attributed to that proximity (Thorsnes, 2002). The standard errors for the attribution of price premiums for houses were several times greater than those for lots, supporting Thorsnes' thesis that heterogeneity among houses led to greater errors in hedonic price evaluations (Thorsnes, 2002). It was also found that lots and houses not immediately proximate to the forest preserves carried very small, if any, price premiums (Thorsnes, 2002). More studies need to be conducted comparing hedonic analyses of house and lot sales to determine whether this new methodology can reduce errors resulting from heterogeneity among houses.

Jim and Chen (2007) used the hedonic price method to estimate the value of green space provision and other environmental amenities in Guangzhou, China. This study was one of the first applications of the HPM in China, as the housing market there has changed from centrally-planned to free market relatively recently. One of the goals of the study was to evaluate the applicability of the method in this newly transformed market (Jim and Chen, 2007).

In China, public listing of housing prices and amenities is not as readily available as it is in the United States and Europe, so a questionnaire on site was used to evaluate housing characteristics. The responses were then checked with real estate agents to ensure their accuracy. In total, 521 sets of valid responses were gathered from 12 different housing sites. Twenty different independent variables were chosen to attempt to explain housing prices, including environmental variables that considered view of green space, view of water, green space provision rate in the residential area, and distance to the nearest park. The hedonic model exhibited good explanatory power, with an adjusted R^2 of 0.725(Jim and Chen, 2007). The view of a green space, view of water, and green space provision rate were all found to be statistically significant positive factors on housing prices, with water views increasing prices by 8.2 percent and green space views by 8.6 percent (Jim and Chen, 2007). While this is an important study that demonstrates the validity of the hedonic method in China as well as the importance of green space provision and environmental amenities, a major lack is an aggregation of the environmental benefits provided by green space, parks, and water amenities for the city of Guangzhou as a whole.

Donovan and Butry (2010) used the hedonic method to value street trees in Portland, Oregon in 2007. This study is interesting for several reasons: first because it values street trees, secondly because it evaluates the type of trees and other tree characteristics, and thirdly because it assesses how trees affect a houses' time on market (TOM) as well sales price.

On-site visits and aerial photographs were used to analyze 2,608 housing sales in the east Side district of Portland. Tree characteristics examined as independent variables included: tree type, diameter, height, pruning characteristics, presence of disease, and crown area. The main fault of this otherwise excellent study is the paucity of housing variables examined. Ten housing characteristics were examined in the hedonic equation.

The results showed that the number of trees and crown area within 100 feet of a house had positive effects on a house's sales price (Donovan and Butry, 2010). Unfortunately none of the other tree characteristics were found to be statistically significant. On average, the two tree variables added $8,870 to the value of each house, approximately 3 percent of its selling price. Aggregating this to all of the houses in the East Side of Portland produces a total value estimate of $1.12 billion. The additional tax revenue generated was estimated at $45 million (Donovan and Butry, 2010). While the results were extrapolated to all of Portland, the authors caution that data does not exist to show that the houses and tree characteristics were similar enough in both districts to make these comparisons. The analysis of TOM showed that the number of trees and crown area both slightly decreased TOM, by on average about 1.7 days (Donovan and Butry, 2010).

While this study looks at some previously unexplored urban tree characteristics to estimate their effect on housing prices and time on market, these variables are unfortunately not found to be significant. The model could still be extended to other locations where these tree characteristics may prove to be significant. Another next step in this line of research would be to include the value of parks and residential trees into the model. The study does provide another demonstration of the value that urban forests add to housing prices, increasing the amount of scientific literature that highlights the benefits provided by urban forests.

While hedonic pricing methods can help to capture formerly unquantified benefits of urban forests, they are only part of the picture. Only the values attached to housing are captured, excluding values for pollution control, recreation, aesthetic benefits, biodiversity benefits, and other categories of benefits that are ignored in this model. Typically hedonic evaluations also include a small segment of the housing units in a given city or town, excluding the monetary benefits attributed to urban forest resources from those who live in more disparate areas not included in the studies (Tyrvainen, 1997). Another issue is that while some hedonic studies solely examine forested areas, many also include forested recreational areas, so similar to the travel cost and contingent valuation methods, values attributed to other aspects of the parks (such as playgrounds, picnic areas, etc) than forested areas can be included in the valuation estimates unless they are carefully separated out. The theory behind the hedonic model, similarly to contingent valuation, implies full information about all of the housing and environmental attributes in question, something that may not always be the case (Hoevenagel, 1994b). Another assumption made by HPM is equilibrium in the housing market, which is not

always the case, such as in instances of government intervention (Hoevenagel, 1994b). The last questionable assumption involved in the construction of the hedonic price method is that all of the environmental benefits provided by a non-marketed resource are capitalized into housing prices, rather than also being incorporated into wage rates or the prices of other goods and services (Mitchell and Carson, 1989). HPM also only measures values attributed to forests by those who can afford to pay for the amenities (Tyrvainen and Miettinen, 2000).

The Travel Cost Method

The travel cost method of valuing nonmarket environmental goods was first proposed by Harold Hotelling in 1947 (Kahn, 1995). The theory is that if travel cost is the majority of expense for visiting a site, it can act as a proxy for the price of a site. This allows the formulation of a demand curve for the site (Kahn, 1995). The function of a demand curve in economics is to show the quantity of a good that will be demanded by consumers if offered at a certain price by suppliers or producers of that good. If the quantity of travel and travel cost vary between sites according to the quality of environmental benefits available at the sites, estimations can be made of how much more people are willing to pay for changes in the quality of environmental benefits at recreation sites (Blomquist and Whitehead, 1995). This method is very difficult, because it requires the gathering of a considerable amount of data from a large number of sites of differing environmental quality (Kahn, 1995). Similar to the hedonic method, the main advantage of the travel cost method is that it is a revealed preference method that uses

actual market transactions to establish values for environmental goods rather than the hypothetical, stated preferences of the contingent valuation method (Hoevenagel, 1994b).

The majority of travel cost studies have valued remote rather than urban environmental amenities. This makes sense, as there is a greater travel cost associated with these resources. There have been a few applications of the travel cost method towards urban forest resources, however. Dwyer et al. (1983) valued three urban forest sites in Chicago using the travel cost method in 1983 (Dwyer et al., 1983), and Lockwood and Tracy valued Sydney, Australia's Centennial Park in 1995 (Lockwood and Tracy, 1995).

Dwyer et al. (1983) developed travel cost models for three urban forests sited in the Chicago area. The three areas modeled were Morton Arboretum, Lincoln Park Conservatory, and Garfield Park Conservatory. The respective WTP in terms of travel cost for each site was $12.71, $8.68, and $4.54, respectively (Dwyer et al., 1983). It is noted that a number of other factors than each sites urban forest amenities influence each WTP figure. For example, the zoo and other attractions connected to Lincoln Park Conservatory probably make $12.71 an overestimate of the WTP for its forest amenities, conversely the poor conditions of neighborhoods surrounding Garfield Park Conservatory probably contribute to a lowering of the WTP regarding its urban forest amenities (Dwyer et al., 1983). The authors call for the development of more sophisticated models that survey travel costs to parks separating out all of the different amenity factors that affect visitors WTP via travel costs.

Lockwood and Tracy estimated the nonmarket economic value of Sydney, Australia's Centennial Park using both contingent valuation and the travel cost method

(Lockwood and Tracy, 1995). Centennial Park received over three million visitors in 1993 (Lockwood and Tracy, 1995). Their main focus was the inclusion of the cost of time into the travel cost equations. Not measuring the utility of the time spent visiting an amenity is a weakness of many travel cost studies. Lockwood and Tracy valued the opportunity cost of time at 29 percent of the wage rate, which is similar to the 33 percent used in many commuter studies (Lockwood and Tracy, 1995). Their estimation of the value of the park, based on 535 completed travel cost surveys, were between 23 and 33 million dollars, with six million dollars of this value coming from the opportunity cost of time (Lockwood and Tracy, 1995). These results speak to the high dollar value of a major park in a major metropolitan area as well as the importance of including the opportunity cost of time in such studies.

Despite the travel cost method being one of the major methods used to measure use values of environmental resources; it is probably not the right methodology to apply to monetizing the urban forest of a city. While the main issue is that generally only recreational areas are valued using this method and segments of the urban forested located on city streets and private homes are not valued, there are other issues with the travel cost methodology. These problems with the travel cost models are that they have not been fully refined enough yet to determine how values change at a site when environmental quality is degraded due to the problems associated with assigning values to sites with differing levels of environmental quality; and that since only recreational users of a site are evaluated, only a subset of the population which might value the site are being examined (Kahn, 1995). The existence or non-use values of the site are also not examined in these models.

Consumer Preferences

Beneficial increases in consumer perception of downtown main street business districts are a benefit of urban forests that has been examined but not explicitly quantified. National studies as well as specific city studies have been performed by Wolf at the University of Washington (Wolf, 2005; Wolf, 2004).

The theoretical background of this research lies in consumer preference theory. Much work has been completed analyzing how the interior of a store (lighting, music, layout, etc.) influences consumer preferences, but little previous work examined store exteriors and environment. Wolf hypothesized that the presence of trees would positively affect consumer perceptions of individual stores as well as business districts as a whole, based on previous work that had established the contribution of urban forests to positive place meanings and values (Wolf, 2005).

Surveys were designed and distributed in large, midsize, and smaller cities throughout the United States. Respondents were asked to rate images of downtown business districts based on the four concepts of: visual quality, place perceptions, probable patronage behavior, and product pricing. These images progresses from a "no trees" scenario to a scenario with abundant, older large trees. Positive correlation was found in all four concepts between an increase in the number of trees and an increase in consumer preference (Wolf, 2005). Trees were associated with higher rating of amenity and visual quality, a greater likelihood of return patronage, and even a willingness to pay more for the same goods across product categories (Wolf, 2005).

These results suggest that urban forests have a significant unexplored value as visual marketing tools. Their aesthetic contribution to downtown business districts should be included in policy considerations regarding urban forestry and downtown revitalization. A benefit/cost analysis would be the next logical step in this research (Wolf, 2005). While this is another piece in the puzzle that should not be ignored when capturing the values of urban forest resources and incorporating these values into policy decisions, there are many other larger pieces that can be captured by established techniques such as contingent valuation, hedonic valuation, or the travel cost methodology.

Rainfall Interception

The interception of rainfall by urban forests plays an important role in the urban ecosystem (Xiao, and McPherson, 2003; Chen and Jim, 2008). Canopy rainfall interception alters the urban runoff process by reducing the flow rate and shifting the runoff concentration time via temporal water storage on the canopy surface (Xiao, and McPherson, 2003). The reduction of urban runoff reduces expenses for control and pollutant treatment. This benefit of urban forests has been discussed often but rarely quantified. Estimating the value of this urban forest benefit can help to ensure a more efficient distribution of urban forest resources.

Xiao and McPherson studied and quantified the interception of Santa Monica, CA's municipal urban forest. Santa Monica was selected because it has an extensive public tree inventory and detailed information on its tree and storm runoff programs. The

study was limited to public street and park trees, with a population of 29,229. A single tree interception model was used to simulate the rainfall interception of each tree. The total rainfall interception was determined by a linear calculation. Six hundred and six trees were sampled to construct the interception models for each species and size. Meteorological data were inputted into the model with hourly values. The benefits were based on estimated values for treating sanitary wastewater and the cost of controlling local flooding during a 25-year storm.

Annual rainfall interception was found to be: 193,168 m^3 or 6.6m^3 per tree. The implied value of this interception was estimated to be $110,890, or $3.80 per tree. $3.20 of this value was attributed to avoided storm water treatment and $0.60 came from avoided flood control costs (Xiao, and Mcpherson, 2003).

The five city study conducted by McPherson et al. mentioned previously also considered the value of rainfall interception (McPherson et al., 2005). Xiao's methodology for calculating rainfall interception was used for the five cities. Storm water reduction benefits were calculated by developing a life-cycle cost model of storm water detention/retention over twenty years, and then dividing the cost by the volume stored over those years to determine the cost per gallon (McPherson et al., 2005). The product of this figure and the yearly amount of rainfall interception by the city's urban forests determined the annual benefits. Bismarck had the highest benefits, at $496,227. This was attributed to the high interception rate as well as the high cost of detention/retention in that city (McPherson et al., 2005). Ft. Collins, Cheyenne, Berkeley, and Glendale had storm water runoff reduction benefits of $403,597, $55,297, $215,648, and $37,298, respectively.

This is another benefit of urban forests that needs to be considered in land use discussions and decisions. The number of trees, species composition, and pruning practices can all affect the value of storm water runoff for urban forests (Xiao, and Mcpherson, 2003). Less frequent and intensive tree pruning can increase rainfall interception rates, as they alter the crown volume and leaf area of trees (Xiao, and Mcpherson, 2003). While this benefit should be included in policy decisions, it is only a small piece of the overall group of benefits provided by urban forests. Non-use values are one of the many benefits missing from this valuation method.

Conclusion

The valuation of nonmarketed environmental resources was first proposed over sixty years ago, but it remains a contentious field (Smith, 1993). Many different methods have been proposed, each with their advantages and disadvantages (Hoevenagel, 1994b). And of course there are those who feel that the act of valuing these resources in itself is unethical (Smith, 1995).

Although consumer preferences for forested downtown business districts and storm water retention are two novel methods for estimating a value for urban forest benefits that have not been previously monetized, they are not suitable for the type of benefit estimate that this study is attempting. They capture only a portion of the benefits conferred by an urban forest resource, while an estimation of total benefits is the goal of this investigation. This is the main reason why contingent valuation is chosen as the best method of the three traditional economic valuation methods presented here. It is the only

one of the three methods that can estimate the total benefits conferred by an environmental resource, including non-use values (Mitchell and Carson, 1989; Boyle, 2003).

Contingent valuation, like any other valuation method, is not without its drawbacks. The main disadvantage of using this methodology is that it involves hypothetical rather than actual consumption decisions revealed through surveys. This is also the main source of criticism from economists who prefer the use of revealed preference estimation methods (Hanemann, 1996), leading to the validity of estimates from contingent valuation surveys being questioned (Hausman, 1993). Fortunately there exist the guidelines established by NOAA in 1993 (NOAA, 1993) and decades of methodological experimentation and advancement. These resources are used to construct a methodology that seeks to avoid all of the possible systematic sources of error presented in critiques of the contingent valuation method.

Tampa's urban forest has already been assessed, and some of its benefits have been quantified. These benefits can then be considered when making land use decisions in Tampa so that utility can be maximized for residents and visitors. Valuing further benefits will provide more information to be considered in these situations and allow for more complete cost-benefit analyses. This will allow for a more complete maximization of utility.

Before advancing to the methodology, however it is appropriate to construct a description of the City of Tampa, the study area for this contingent valuation exercise. The current state of the City's urban forest as well as its social and economic characteristics is considered.

CHAPTER TWO:

THE STUDY AREA, RESEARCH QUESTIONS AND HYPOTHESES

The Study Area

The City of Tampa is the site for this study. Tampa (28N, 82W) is on the west coast of Florida, close to the mid-point of its peninsula. A map of the city is presented in figure1.

The City's population was 280,015 in 1990, 303,447 in 2000, and estimated at 341,137 in 2008 (US Census Bureau, 2000; US Census Bureau, 2008). It was estimated that there were 135,555 households in the city of Tampa in 2008 (US Census Bureau, 2008). The City is more ethnically diverse than the United States as a whole, at 66.6 percent white compared to 74.1 percent for the nation (US Census Bureau, 2008).

Included in this greater diversity is a much larger Hispanic or Latino population, at 22 percent compared to 14.7 percent for the nation as a whole (US Census Bureau, 2008). It is important to capture this ethnic diversity when conducting a survey of Tampa residents. This is especially a concern when considering public provision of environmental goods, as research by Alozie and McNamara in Phoenix (2008) demonstrated that Latinos were more willing to pay for public services than their Anglo counterparts, even when accounting for income differences.

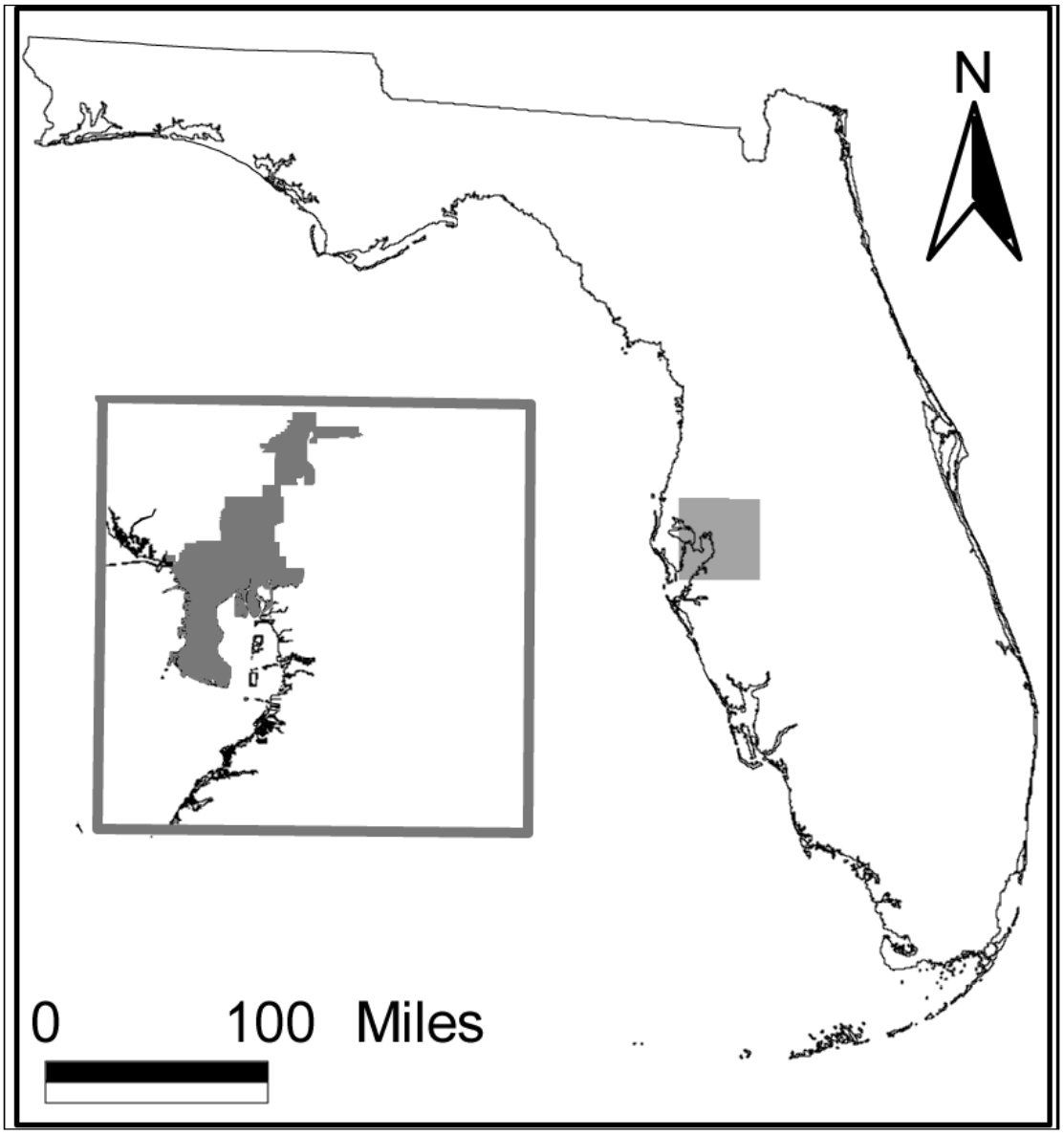

Figure 1: The City of Tampa (Andreau et al., 2008

While these ethnic differences might not translate exactly from Phoenix to Tampa, it is still important to take them into consideration. It is also a concern regarding language barriers in any form of surveying, as it was estimated by the US Census Bureau in 2007 that 25.2 percent of Tampa's population over the age of five spoke a language other than English at home (US Census Bureau, 2008).

The City of Tampa is concerned with its urban forest resource, as evidenced by the commissioning of ecological analyses of these resources in 1996 and 2006 (Campbell and Landry, 1999; Andreau et al., 2008). This concern resulting in these ecological analyses has provided researchers with rich descriptions of Tampa's urban forest resources. The most recent study, finished in 2008, found that there was an increase in tree cover overall citywide between 1996 and 2006, with tree cover in 2006 appearing to have returned to the levels seen in the 1970s (Andreau et al., 2008). The number of trees in the City of Tampa was estimated at 7,817,408, with red mangrove, Brazilian pepper, and black mangrove being the three most popular species (Andreau et al., 2008). Twenty nine percent of the City was estimated to be covered in tree canopy (Andreau et al., 2008). Tree canopy cover estimates from different cities across the United States are presented in Table 1. While it is important to remember that these figures are the results of four different studies performed in different years and using different methodologies, Tampa is still one of the more forested cities of those studied.

There has also been a preliminary study conducted to assess residents' perceptions in Tampa concerning Hillsborough County's urban forest resource (Escobedo e al., 2008). Stakeholder analysis and group meetings with urban and suburban residents were used to design a survey intended to assess residents perceptions of the costs and benefits related to urban forests in the County. Urban forests were defined for the purpose of this survey as "trees along streets and in yards, woodlands, forests, and natural areas found in and around places such as neighborhoods, cities and towns (Escobedo et al., 2008)." Six hundred and forty-one surveys were mailed out to homeowner association leaders throughout the county in the summer of 2007, yielding a 24 percent response rate,

Table 1: Urban Tree Canopy Cover Percentages

City	Tree Cover %
Atlanta, Ga[a]	36.7
Houston, Tx[d]	30
Baltimore, Md[a]	25.2
Syracuse, Ny[a]	24.4
Boston, Ma[a]	22.3
Oakland, Ca[a]	21
New York, Ny[a]	20.9
Chattanooga, Tn[d]	16.6
Philadelphia, Pa[a]	15.7
Los Angeles, Ca[c]	15.4
Sacramento, Ca[c]	14.1
Jersey City, NJ[a]	11.5
Tampa, FL[b]	29

a=Nowak et al. 2002;
b=Andreau et al. 2008;
c=Mcpherson and Simpson 2003;
d=Chen and Jim 2008.

or approximately 130 completed surveys. The top four benefits perceived by respondents were: improves aesthetics, provides shade, increases property values, and provides unique community character, respectively (Escobedo et al., 2008). The top four costs perceived were: hurricane damage from trees; falling branches and trees on power lines, tree damage to sidewalks, roads and foundations; and blocked signage; respectively (Escobedo et al., 2008). While this study had a small sample size and is not representative of the population of Hillsborough County as a whole, it can still be used to provide information to policymakers on the perceived benefits and costs of urban forests to Hillsborough County residents. This information could then be used to aid in the construction and distribution of urban forest resources in a manner that better fits the

perceptions of residents. It could also be used to design educational programs that would result in such a construction and distribution by homeowners and developers. The next step would be to develop a similar survey and use it to get results that are representative of the City of Tampa. Part of the contingent valuation survey employed in this study will be directed towards assessing the perceptions of residents of the City of Tampa to add to this information already obtained by Escobedo et al. (2008).

The most recent Urban Ecological Analyses noted an increase in tree cover between 1996 and 2006 that brought this metric back to that of the 1970s despite decreases in tree cover during the 1980s and early 1990s (Andreau et al., 2008). They were unable to determine the reasons for this increase in tree cover, or predict future changes to tree cover in the City (Andreau et al., 2008). This is understandable, as determining such figures and values would require an incredibly in depth study beyond its scope. Obviously, one of the key drivers of change in tree canopy cover is the value given to this tree canopy by officials, planners, and developers. To ensure equitable and efficient distribution of this important urban forest resource it is important for the value attributed by citizens of Tampa to be known and understood by those who will determine said distribution. A contingent valuation survey of Tampa's urban forest resource can fill this information gap and help policymakers make decisions concerning land use and development that affect the urban forest resource.

Research Questions and Hypotheses

A review of the contingent valuation literature along with an analysis of the study area (the City of Tampa) has allowed for the construction of two research questions that guide the remainder of this work.

Question One: Do the residents of the City of Tampa value an increase in the City's urban forest resource?

Hypothesis: An increase in the provision of the City of Tampa's urban forest resource would be valued by residents.

Question Two: Do levels of willingness to pay expressed by respondents correspond with prevailing economic and preference theory?

Hypothesis: Willingness to pay estimates garnered from this study will conform to the prevailing economic and preference theories. WTP will correlate positively with income, education, environmental preferences, and use and knowledge of Tampa's urban forest resource.

CHAPTER THREE:

METHODOLOGY

Introduction

A contingent valuation study was designed and executed to measure the economic value of an increase in the provision of Tampa's urban forest resource. Given the complexity involved in contingent valuation studies, a detailed methodology is outlined below this introduction. Different methodological techniques are compared and decisions to choose one over another are justified. Contingent valuation was chosen as a methodology because unlike many other available methods of valuing nonmarketed environmental resources, it can measure both use and existence value of said resources (Lant and Tobin, 1989). Theoretically, it measures all the value assigned by respondents to the resource in question. Contingent valuation is also more suitable for measuring the benefits conferred by an entire city's urban forest resource than the travel cost or hedonic price methods, which typically measure the value of single forests or forested parks. This is still an anthropogenic valuation, ignoring any inherent value in environmental resources themselves that is not attributed to them by humans. Despite its anthropogeneity and other criticisms of contingent valuation covered in the literature review, it is the most common method of valuing nonmarketed environmental resources

(Boyle, 2003; Tyrvainen, 2001). Using contingent valuation to evaluate the benefits of Tampa's urban forest resource can aid policymakers in making decisions about the provision and maintenance of this resource.

In 1993, a panel commissioned by the National Oceanic and Atmospheric Administration (NOAA) that included two Nobel Laureates in Economics as co-chairs, provided an extensive unbiased academic assessment of the contingent valuation method. The panel received hundreds of pages of commentary on the issue and heard from both sides of the debate in public meetings (NOAA, 1993). The panel concluded that "CV studies can produce estimates reliable enough to be the starting point of a judicial process of damage assessment (NOAA, 1993 p 4610)." A set of guidelines were laid out that would permit the construction of studies that would be acceptable for such judicial purposes. Regarding their guidelines, the NOAA panel concluded: "… the more closely the guidelines are followed, the more reliable the result will be (NOAA, 1993, p 4610)." Although the stringency of the NOAA guidelines has been called into question (Carson at al., 1996), and the NOAA panel itself acknowledged that studies were still valuable without all of the guidelines being met (NOAA, 1993), this study followed the NOAA guidelines closely. They have been frequently cited as the appropriate guidelines for executing a contingent valuation study (Champ et al., 2002). It is important to recognize that the NOAA guidelines were constructed for the recovery of damages in natural resource damage assessments, and thusly designed to withstand legal scrutiny (Lindsey et al., 1995). As this study is not designed for such an application, it was not requisite that the guidelines be met in their entirety. The guidelines cover all aspects of a contingent valuation study: introductory questions, survey design, pilot testing, sampling, survey

execution, data analysis, and reporting. There is a vast body of literature regarding contingent valuation (although few applications of the method to value urban forests) constructed before and after the recommendations of the NOAA Panel that is used to facilitate the implementation of their guidelines as well as guide methodological concerns not covered by the NOAA guidelines.

Survey Design

General Concerns

Contingent valuation surveys are intricate and complex, hard to design, although the NOAA guidelines and many previous studies exist to guide the construction of a well-designed study. There is also a vast field of literature regarding all aspects of the task of surveying. Unfortunately, each resource to be valued is different, which prohibits the use of previous studies as anything other than guidelines (Mitchell and Carson, 1989). Each study area is also different, and the contingent valuation survey needs to be carefully tailored to the environmental, political, and social situations in each area, be it a neighborhood, town, city, state, or country (Tyrvainen, 2001).

Introductory Questions

Most contingent valuation surveys begin with an introductory section that helps set the general context for the scenario being developed (Carson, 2000). This section

consists of general attitudinal questions that apply to the resource in question and the environment in general. This is in line with the NOAA guidelines, as they call for this type of preference information to be included in the results of any contingent valuation study (NOAA, 1993). For this contingent valuation of Tampa's urban forest resource, these questions included: attitudes toward the environment, attitudes toward government and government provision of resources, perceived beneficial and detrimental effects of trees in urban settings, levels of knowledge about urban forests and where this knowledge is obtained, use of urban forest resources, and other attitudinal questions. The complete survey is available in Appendix One. This preference information can help policymakers determine the desired provision of urban forest resources by Tampa residents.

These introductory and attitudinal questions can also be thought of as warm up questions (Whitehead, 2006). They are relatively easy for respondents to answer before moving along to the difficult valuation questions, getting them ready for the important valuation decisions that require some serious thought (Whitehead, 2006). These preference results can also be analyzed against WTP values obtained to help validate the results of a contingent valuation study. These questions are best developed by consulting the existing literature and adapting it to the specific resource and location in question before moving to cognitive interviews for final refinement.

Scenario Construction

"*The principal challenge facing the designer of a CV study is to make the scenario sufficiently understandable, plausible, and meaningful to respondents so that*

they can and will give valid and reliable values despite their lack of experience with one or more of the scenario's dimensions (Mitchell and Carson, 1989, p 120, emphasis in original)." This is so much the case that one early review of contingent valuation methodology only recommended its use in cases where respondents were familiar with the resource in question (Cummings et al., 1986). It has since been shown that a well-crafted scenario can succeed in giving respondents enough information about a resource with which they are not familiar to assign their values to it (Mitchell and Carson, 1989; Boyle 2003). The nonmarket environmental resource being valued by each study guides its scenario construction. The scenario in a contingent valuation study attempts to create a hypothetical market in which the environmental resource in question can be valued. It is important to develop a clear description of the physical change in resources that will be affected by the policy change enabled by the valuation process. This way the valuation is tied to the specific change in utility that it affects. In other words, "a concrete scenario allows each respondent to understand what, exactly, they are paying for (Whitehead, 2006 p 72)." Otherwise, respondents are left with no option other than to value the policy change itself (Boyle, 2003). This can be a major problem, as valuations of policy change are based on the different assumptions individuals hold regarding the policy change in question, which will lead to different levels of resource change being valued by different respondents (Boyle, 2003). Effort was made to obtain previous surveys from similar valuation efforts so that they can assist in all facets of survey design, although as mentioned previously, it is important to take into account the different social factors between different locations when using previous surveys from different locations in the design of a survey from new locations (Tyrvainen, 2001).

Where respondents are not aware of the current extent of the resource in question as well as the services it provides, this information must be included in the valuation scenario (Boyle, 2003). This can then be compared to the change in resource and service provision enacted by the policy change in question by respondents and assigned a monetary value. This is accomplished in this study by identifying the number of trees in Tampa's urban forest (approximately 3.4 million) directly before the valuation question and reminding respondents of the urban forest definition used for this study.

The change in provision of forest resources and services that would occur given a policy change of increased financial support of "x" dollars was developed to enable an accurate description of both the existing and new conditions. This is reflected in question twelve of the contingent valuation survey developed: **If there was a ballot proposal for a one-time tax of $x to increase Tampa's urban forest citywide, on all types of land uses by 250,000 trees of all types, would you vote <u>for</u> or <u>against</u>, remembering your household's expenses and budget constraints?** The potential increase of 250,000 trees was chosen based upon the medium bid level of seven dollars multiplied by the City of Tampa's adult population, divided by the average cost of tree provision under the City's Community Tree Program to make the scenario as realistic as possible. The selection of bid levels will be discussed later. The scenario included the most recently estimated number of trees in Tampa, 3.4 million (Andreu et al., 2008) and a reminder of the definition of urban forests used for this project. The scenario was carefully tested by cognitive interviews to ensure that it is understandable and plausible. The population's perceptions of the resource in question are very important in framing the valuation scenario (Smith, 1993), and previous examinations of the perceptions of Tampa residents

towards their urban forest resource (Escobedo et al., 2008) were used to construct the valuation scenario.

Mitchell and Carson (1989) characterize the information issue as a tradeoff between the need to inform the respondent about the hypothetical market created and the need to avoid information overload. While an overabundance of relevant information may be become burdensome to the respondent and cause tiredness or boredom, it is also possible that the presence of irrelevant information (or what is perceived as irrelevant by the respondent) may cause annoyance with the process and also have a negative effect on results garnered by a contingent valuation study (Bateman and Mawby, 2004). It is also important to note that while economic theory posits full information in all market transactions, this is often not the case (Kahn, 1995). Despite the lack of full information in some market transactions, it is still essential to come as close as possible to full information in the hypothetical scenario. According to the NOAA guidelines "A 'conservative' CV study, i.e., one that avoids overestimating true willingness to pay, will no doubt exceed the minimum standard of information (NOAA, 1993, p 4606)." The need for information depends upon the environmental resource in question as well as the group of respondents valuing said resource. The more familiar the respondents are with valuing the resource in question, the less information is needed in the survey about that good (Bateman and Mawby, 2004; Hoevenagel and Van Der Linden, 1993). While Tampa residents may be familiar with their urban forest resource on some levels, for many it is probably not a good for which they are familiar with forming preferences and values. This may require a good amount of background information about the resource and the amenities that it provides. The level of information provision and its effects is one

of the major issues facing any contingent valuation study that is best addressed by careful planning and pilot testing (Mansfield and Pattanayak, 2007).

Valuation Question Mode

There are many different techniques for asking the willingness to pay question in a contingent valuation survey. These include open-ended, dichotomous choice, payment card, and iterative bidding question forms (Tyrvainen, 2001). There have been critiques of each of these question techniques, and the iterative bidding technique has been abandoned almost completely due to what is termed anchoring effects, which involve the initial bid proposed having an effect on the eventual WTP of each respondent (Boyle, 2003). The dichotomous choice format is the most common methodology currently used (Boyle, 2003; Carson, 2000), although each method has its advantages and disadvantages (Boyle, 2003). Some have even said that no one method is superior to the other methods (Tyrvainen, 2001; Whitehead, 2006). The NOAA guidelines call for the valuation question to be posed as a vote in a referendum, using the dichotomous choice question format (NOAA, 1993). Their main reason for this is the agreement that the all or nothing, yes/no format of dichotomous choice questions mimics consumption decisions in market purchases (NOAA, 1993). Referendums themselves will also be familiar to respondents, and some real-life referendums deal with the provision of public goods, which is thought to facilitate understanding by respondents of contingent valuation studies posed as referendums (Mitchell and Carson, 1989). This might be the reason why dichotomous choice as an elicitation method has been shown to have a positive effect on the response

rates of mail contingent valuations surveys, holding all other factors constant (Schneeman, 1997). Another reason was the theory that open-ended questions would result in over-bidding by those emotionally invested in the resource, although there have been arguments that open-ended questions produce reliable value estimations (Tyrvainen, 2001), and the methodology is still in use. Another criticism leveled against the open-ended format is that respondents treat it as an auction, and are thus willing to pay what they believe is the required amount to purchase the resource change in question rather than their true willingness to pay (Hanemann, 1996). A disadvantage of the dichotomous choice method is that it requires a larger sample size, as multiple bid amounts must be surveyed and then unscrambled statistically (Mitchell and Carson, 1989).

Another disadvantage is that in some studies it has been found that respondents answer a dichotomous choice question as if they are voting on an environmental issue rather than establishing their WTP for the environmental change in question (Hoevenagel, 1994). Both dichotomous choice and payment card surveys are also subject to anchoring biases, although less so than the abandoned iterative methodology (Boyle, 2003). It has been theorized, however, that these anchored WTP responses are still better than those obtained through the open-ended question format (Hoevenagel, 1994). This is because the open-ended format requires respondents to form on their own a valuation for the environmental change or resource in question, rather than make a yes/no decision (dichotomous choice method) or pick from a set of supplied values (payment card method). This difficulty, termed cognitive burden, in producing a value for a previously unconsidered commodity can lead to higher non-response rates and a greater percentage of protest bids (Hoevenagel, 1994; Hanemann, 1996). The dichotomous choice

methodology was used in this survey. Bid amounts were carefully selected based on cognitive interviews, economic literature, and previous surveys. Generally dichotomous choice surveys use five to eight bid amounts grouped around the mean willingness to pay found in either pilot tests or previous surveys (Boyle, 2003). There is a small body of research surrounding optimal bid design, but information regarding the distribution of WTP is necessary for it to be applied to a contingent valuation study (Haab and McConnell, 2002). Three bid levels of 5, 7, and 9 dollars were used in the execution of this survey. Financial and temporal concerns constrained the number of bid levels, as thirty responses from each bid level allow the assumption of normality to be tested. Obtaining thirty responses from five or eight bid levels would require two thirds to one and two thirds as many surveys sent out to receive the same number of responses per bid, or a longer time for the survey process and more points of contact. Bids were grouped around the midpoint of seven dollars to provide a conservative estimate of the willingness to pay of Tampa residents for improvements to their urban forest resource. The three bid levels were equally assigned to each of the four strata developed in the sample using a random number generator (Random.org).

Payment Vehicle and Payment Rule

Another important aspect of scenario creation is the payment vehicle. This is the method by which the increase in or protection of the resource in question is affected. The most common payment vehicles for contingent valuation studies are entrance or user fees, water or utility fees, contributions or donations to special funds, increases in the

prices of related goods, and taxes (Whitehead, 2006). The NOAA guidelines do not specify a preferred payment vehicle (NOAA, 1993). The selection of payment vehicles is another double-edged sword similar to that of information provision. If a payment vehicle is unrealistic it may be rejected for rendering the entire scenario unrealistic, but a realistic payment vehicle may be rejected due to dislike for the form of the vehicle itself, such as tax increases (Boyle, 2003). In this situation where the payment vehicle results in bid rejection, it is the policy rather than the environmental good itself that is being valued (Mitchell and Carson, 1989). It has been found that the choice of payment vehicle can influence welfare estimates in contingent valuation studies (Mitchell and Carson, 1989; Boyle, 2003). The perceived fairness of the payment vehicle and the scenario itself as well can also influence welfare estimates, which logically increase with the level of perceived fairness (Ajzen et al., 2000). Included in the payment vehicle must be a temporal aspect that fits the created hypothetical scenario. It must be clearly specified whether the payments are one-time or annual. If they are annual, discounting of future payments by respondents should be part of the scenario construction (Boyle, 2003). The one-time increase in provision of Tampa's urban forest resource is compatible with a one-time payment vehicle. Careful focus group, cognitive interviews, and pilot testing work along with examination of previous surveys is the best method to choose a payment vehicle with minimal effect. A one-time tax increase was chosen as the payment vehicle for this contingent valuation study after much careful deliberation. Despite the negative social stigma attached to tax increases, they were thought to be the most realistic method to enable an increase in the provision of Tampa's urban forest resource.

A closely related aspect of scenario creation is the payment rule. This is situation in which the hypothetical payments will take place. It must be believable and enforceable for the scenario itself to be plausible (Whitehead, 2006; Boyle, 2003). This is also termed "incentive compatible", which means that respondents believe that their valuations can be enforced, giving them an incentive to produce truthful valuations (Whitehead, 2006; Champ et al., 2002). Increasing the scenario's level of incentive compatibility will serve to decrease hypothetical bias, warm glow bias, social desirability bias, and protest bids, as respondents are less likely to give values other than those that they truly have for a scenario that they believe will actually be carried out (Harrison, 2007). Voluntary contributions have weak incentive compatibility, as there is no way to enforce their collection, unlike government taxes or fees (Whitehead, 2006). Another example of a weak incentive compatibility situation is permits or user fees that are not readily enforceable. The form of the valuation question has also been found to affect the incentive compatibility of a contingent valuation study (Champ et al., 2002), with dichotomous choice referendums holding the highest level of incentive compatibility.

The payment rule for this scenario was designed through examination of previous surveys as well as cognitive interviews. While not explicitly stated, the payment rule here follows that of a typical ballot measure that will pass if voted for by the majority. This serves to make the hypothetical valuation scenario incentive compatible.

Unit of Measurement

An important aspect of contingent valuation studies not included in the NOAA guidelines is the identification of a unit of measurement for values. Mitchell and Carson (1989) advocate for the use of households as the unit of measurement. One potential drawback to this methodology is that respondents are required to assess how the benefits of environmental change will affect their entire household, rather than just themselves (Hoevenagel, 1994). It is unclear whether individual or household values are superior in the stated preference utility estimates of a contingent valuation study (Boyle, 2003). Carson (2000) later relaxes his stance on the unit of measurement issue and says that it should be correlated with the payment vehicle of a study (Carson, 2000). This based upon the premise that it is easier to estimate household values for payment vehicles such as taxes or utility bills that are paid by households, and easier to estimate individual values for payment vehicles such as entrance fees that are paid by individuals (Carson, 2000). Whichever unit of measurement is chosen, it is important to explicitly identify that unit in the valuation scenario. Individuals were chosen as the unit of measurement for this study, based upon previous urban forest valuations, cognitive interviews, incentive compatibility, and correlation with other demographic data sources to allow for comparison.

Substitutes, Compliments, and Budget Constraints

It is necessary to remind respondents of substitute and complementary commodities for the environmental resource in question as well as their budget constraints (NOAA, 1993; Bateman and Mawby, 2004). Economic theory posits that substitutes, complements and income fundamentally affect the magnitude of surplus gained by consumption, and it is essential that these factors are taken into consideration by respondents (Boyle, 2003; Bateman and Mawby, 2004). Basically, respondents must be aware that there are other private and public goods that can fit the same consumption niche as the resource in question and that their expenditures for said resource will reduce their other consumption options as well as the fact that there are complementary goods for the resource in question whose consumption will be aided or increased by consumption of the resource in question. The more unfamiliar the hypothetical valuation scenario, the more that respondents must be reminded of substitutes and their budget constraints (NOAA, 1993), otherwise, the valuation scenario would not be simulating the consumption patterns implied by economic theory and any estimation garnered would be invalid. This is especially important in contingent valuation studies, as the environmental change being brought about in the hypothetical scenario extends the market and the number of commodity options, other environmental changes that could be brought about by this method need to be referenced to properly remind respondents of substitutes (Hoevenagal, 1994). The proper reminders of substitutes, complements and budget constraints were tested and refined through cognitive interviews and examination of previous studies. Directly preceding the valuation question respondents are asked their

opinion on use of tax money for many different possible public services to remind them of substitutes and compliments as well as assess their opinion of government services and taxation in general. The valuation question itself reminds respondents of their expenses and budget constraints directly. The dichotomous choice referendum format of the scenario should also help to form decision parameters for respondents that are holding with the tenets of economic theory. This will allow for the assumption of full information made in direct market analysis.

"No Answer" Option

The NOAA guidelines also call for the availability of a "no answer" option on the main valuation question as well as a simple yes or no option (NOAA, 1993). This can enhance the reliability of the benefit estimation, as those who are uncertain are no longer forced to answer the valuation question (Mitchell and Carson, 1989). This option is especially important in studies using the dichotomous choice method to mimic referendums, as citizens always have the choice not to vote (Schuman, 1996). The negative associated with this methodological technique that needs to be handled with great care is that respondents can take the easy way out and not put forth the effort to value the resource in question, instead simply giving an answer of no answer/don't know (Mitchell and Carson, 1989). This effect can be minimized by making the survey meaningful and incentive compatible to the respondents. "Don't know" was the form of the "no answer" option chosen for this study after careful examination of other studies and numerous cognitive interviews.

Manipulation Checks

The main valuation question should be followed up by open-ended questions that seek to determine the reason for respondents' answers (NOAA, 1993). These should be coded into categories, such as (1) it is unethical to place a monetary value on the environment (2) Tampa's urban forest resource is as developed as it needs to be (3) other environmental or financial concerns are more pressing, (4) taxes are already high enough, and any other reasons shared by a segment of the respondents. These answers can then be analyzed to determine if valuation decisions were made according to standard economic theory, i.e., whether the respondents were valuing the resource in question based upon the utility received from it rather than rejecting the hypothetical market scenario or the payment vehicle, otherwise known as protest bids (Carson et al., 1996; Krupnick and Adamowicz, 2007). This type of manipulation check was present in question 13 of the survey available in Appendix One. Respondents were asked for the reasons that they voted for or against the hypothetical ballot measure in the question directly after it. Options included: environmental benefits of trees, community benefits of trees, trust in government, clarity of proposal, too many taxes, already enough trees, more important uses for tax money, and a don't know/no answer option. Too many taxes and trust in government as answers to this manipulation check could indicate protest bids, although a positive trust in government could be associated with voting for the proposal.

A contingent valuation survey should include questions that evaluate the respondents' understanding and acceptance of the scenario presented, according to the NOAA guidelines (NOAA, 1993; Boyle 2003). These types of questions are known in

the psychological literature as manipulation checks, meant to test whether experimental subjects interpreted the information provided in the manner intended by researchers (Hanemann, 1996). These questions will determine whether respondents understand the baseline and new levels of Tampa's urban forest resource and whether they accept the possible change affected by the policy implications of the payment vehicle. While respondents may be unlikely to be willing to admit their lack of understanding, especially with an in-person interviewer, it has been suggested that a Likert scale will make it more likely for respondents to admit understanding than a simple yes/no question on understanding (Krupnick and Adamowicz, 2007). Care was taken to design this question in an attempt to achieve true measures of respondents' understanding, using a five point Likert scale that included a don't know/no answer option. It can be found as question fourteen on the survey included as Appendix One. This question will help evaluate the validity of the study, as the NOAA guidelines reject the validity of any study without a high level of understanding (NOAA, 1993).

Demographic Information

As in almost any survey, demographic information was collected in a contingent valuation survey to help evaluate the responses. The standard demographic characteristics such as, age gender, income, ethnicity, education, etc, were included. Most standard demographic questions can be adapted from previous surveys (Whitehead, 2006). Demographic questions particular to contingent valuation as well as the particular environmental resource in question (Tampa's urban forest) included: attitudes toward the

environment, attitudes toward government and governmental environmental management, prior knowledge and perception of the resource, type of area where the respondent grew up (urban, rural, etc.), and use of the resource, among others. The non-standard demographic questions associated with contingent valuation and the City of Tampa's urban forest resource were developed through literature review, review of existing studies and cognitive interviews.

There is no consensus among survey practitioners regarding the placement of demographic questions within a survey (Fink, 1995). Some experts feel like demographic questions should be placed at the end of surveys, as respondents may be more relaxed and possibly more likely to be willing to answer these potentially offensive questions (Mitchell and Carson, 1989). This methodology was followed and the demographic questions were placed at the end of the questionnaire, as questions fifteen through twenty-one, which can be found in Appendix One.

Survey Neutrality

A last important consideration remains surrounding survey design that is often overlooked in contingent valuation studies (Boyle, 2003). This involves the possibility of the study itself providing value cues to respondents. It is important for resource descriptions and valuation questions to remain value neutral rather than fall into this potential pitfall. While survey designers can make every attempt to provide a neutral survey for respondents, question structure, wording, and order can unintentionally provide value cues regarding the resource in question (Boyle, 2003). The context

provided by the hypothetical market scenario will always be interpreted by respondents, and not always in the manner intended by the survey designers (Hanemann, 1996). Respondents' perceptions regarding the fairness of the hypothetical scenario have been shown to influence valuation results in empirical tests (Ajzen et al., 2000). This is another reason why careful and extensive focus group and pretesting work is necessary before any contingent valuation survey can be executed. It is also a reason why manipulation checks are necessary in contingent valuation surveys, although the hope is that these issues can be eliminated in survey design and testing, as a high percentage of failed manipulation checks will invalidate a contingent valuation survey according to the NOAA guidelines (NOAA, 1993). This concern was addressed in the final question of the survey, number 22, which directly asked respondents whether they felt that the survey tried to influence them one way or the other, using a six point Likert scale which included a don't know/no answer option.

Pilot Testing

The NOAA guidelines call for careful pilot testing of a contingent valuation survey before it is administered. According to Mitchell and Carson "Careful use of various pretesting techniques to explore an instrument's weaknesses before taking it into the field is probably the single most effective way to enhance a study's validity (Mitchell and Carson, 1989, p 218)." This is a referral to both focus groups and cognitive interviews, which the NOAA guidelines do not emphasize, as well as pilot testing, which

it does. This study used all feasible methods to develop and refine the survey instrument in attempt to make it a valid estimator of benefits whose findings can aid policymakers.

The focus groups would consist of experts in the varied involved disciplines and sub-disciplines. This would include: forestry experts familiar with Tampa's urban forest, social scientists with surveying expertise, economists, and geographers to evaluate the spatial context of the study. Focus groups would help to refine the survey instrument as well as the surveying techniques employed. If possible within financial and temporal constraints, a trained and experienced moderator would be used for the focus groups in this study. Focus groups would be audio or video recorded so that the moderator and participants can focus on group discussions and take notes later. The financial and temporal constraints encountered by this study resulted in the use of the cognitive interview process in lieu of focus group survey refinement.

A variation on focus groups is the cognitive interview process (Mansfield and Pattanayak, 2007). These consist of one-on-one interviews with experts or individuals similar to the sampling frame. This methodology can utilize open ended questions to get a picture of the perceptions of potential respondents regarding the environmental resource in question (Elmendorf and Luloff, 2001). Cognitive interviews were utilized to weed out unclear questions or directions, missing or extra information, and ensure that the survey is understandable, plausible, and meaningful (Elmendorf and Luloff, 2001). Cognitive interviews were conducted with a population similar to that which would have been included in the focus group process, utilizing the expertise of: forestry experts familiar with Tampa's urban forest, social scientists with surveying expertise, economists, and geographers to evaluate the spatial context of the study

Pilot testing would help to ensure that the survey is understandable, that the policy instrument for resource improvement is plausible, that the payment vehicle is acceptable, that the payment rule is incentive compatible, and that the demographic questions are not offensive. Non-response, item non-response, social desirability or warm glow bias, and protest bids can be minimized through the pilot testing process. It would be executed among members of the defined population for the survey (Tampa residents), so that those who would actually be answering the survey will be evaluating its efficiency. Unfortunately, financial and temporal constraints did not allow for the use of extensive pilot testing in this study.

Pilot testing of photographs or other visual aids to a survey such as maps are called for in the NOAA guidelines (NOAA, 1993). Visual aids can provide great assistance in describing a change in the provision of an environmental good, but they can also have great dramatic impacts upon respondents that do not match the scope of the change in provision (Hoevenagel, 1994). This is more relevant in the natural resource damage assessment framework that the NOAA guidelines were conceived in, where the inclusion of pictures of oil spills or clear-cuts could greatly influence the willingness to pay figures revealed in such a survey through the great emotional impact conveyed by such photographs (Mitchell and Carson, 1989; Hoevenagel, 1994). Pictures or maps were not used in this survey, so this concern about survey neutrality is not applicable to this study.

Sampling

Probability sampling is the method that must be used for any contingent valuation survey to be free enough of error that the results can be considered for legal or policy purposes (NOAA, 1993). It is the only method that can confidently be used to make generalizations from the sample to the general population (Schuman, 1996). "The choice of sample specific design and size is a difficult, technical question that requires the guidance of a professional sampling statistician (NOAA, 1993 p 4610)." It is also important to ensure that the sample is representative of the affected population (Boyle, 2003). In general, the larger the sample size, the smaller the absolute value of standard error in the estimation results (Boyle, 2003; Mitchell and Carson, 1989). "In practice, most studies choose the largest sample size possible given the available budget (Boyle, 2003 p 123)." "If rigorously implemented, findings based on sample sizes as small as 600 to 1,500 people can be representative of the entire United States population (or any other population) with a high degree of confidence (Mitchell and Carson, 1989, p 108)." Probability sampling allows for generalizations from the sample to the larger study population, which makes probability sampling necessary for any contingent valuation study which wishes to make statistical inferences (Champ, 2003). Stratified simple random sampling was used in this study, with all efforts made to produce a geographically diverse sample. The other option for sampling that is appropriate for this type of study is cluster sampling. The proper spatial scale of neighborhoods, block groups or tracts would be chosen to allow for the comparison of different demographic groups while still constructing a random sample that was representative of the City of Tampa.

Cadastral data from February 2010 property appraiser's data was used to construct the stratified sample for this study. The City of Tampa's 2007 boundaries, which have remained unchanged since then, were used to contain the cadastral data. Parcels with centroids inside of city limits were included in the sample frame. Residential land use parcels were extracted. Income and tree cover were the two variables used to construct strata, at the block group level. Block groups that extended outside of city limits were also excluded from the sample frame, resulted in 452 parcels being eliminated from the sample frame, a very small percentage of the total. Census 2000 data were used to stratify income with medium family income at the block group level. Two quantiles were developed around the mean of $36,750. Tree canopy cover data from the Tampa UEA (Andreu et al., 2008) was used to stratify the sample based upon tree cover at the block group level. The mean canopy cover percentage of 26.6 percent was used to construct two quantiles. These stratification procedures resulted in four strata (high income-high tree cover, high income-low tree cover, low income-high tree cover, and low income-low tree cover). The next step in the sampling procedure was the selection of parcels that were hypothesized to be owner-occupied. These parcels were chosen for the sample frame so that personalization could be effected in survey execution (the importance of which is talked about later in this section) and so that surveys could be guaranteed to be mailed to the intended respondents. The owner-occupied hypothesis was developed by matching owner's addresses with site addresses. The final limitation on the sampling frame was the exclusion of all other residential land use than single family residential, condo, and townhouse/villa. This was once again to ensure the effectiveness of personalization and the intended sampling units receiving the surveys. These sampling

procedures resulted in a sampling frame of 71,752 parcels hypothesized as owner-occupied out of 112,244 total residential parcels in the City of Tampa, or approximately 64 percent of residential parcels. The distribution of sampling units in the sample frame by strata is shown in table 2.

Table 2: Sample Frame by Strata

Strata	Parcels	Proportional Share of Sample
High Tree-High Income	29,983	209
High Tree-Low Income	15,261	106
Low Tree-High Income	13,394	93
Low Tree-Low Income	13,114	92

The next step in the sampling procedure required a careful decision. This was the manner in which to select the five hundred sampling units from the four different strata. Table 2 shows how one option, selecting proportionally from each strata would proceed. There were several concerns associated with this option. Forty percent of sampling units would be chosen from the high income-high tree cover strata if this method was followed. The concern of oversampling Tampa residents with a high income is exacerbated by the fact that the sample frame has already been limited to those who are hypothesized to be homeowners. This concern, coupled with the theory that low income populations are less likely to respond to surveys (Fink, 1995; Mitchell and Carson, 1989), led to the decision to select an equal number of sampling units from each strata (125).

Random sampling procedures and random number generators within SPSS (Field, 2005) were used to choose 125 sampling units from each strata. Estates, trusts, properties, holdings, and care of designations were removed from the sample and replaced by

random sampling within the appropriate strata; twenty-eight cases were adjusted this way to ensure that the intended respondents received surveys. Many properties were owned by two people, presumably couples for the most part. Sample units were chosen by a process of eliminating the first or second name back and forth between sequential units to result in a single potential respondent. One hundred and eight first and second names were removed from the sample in this manner.

The spatial distribution of the sample is shown in Figure 2. When compared with the latest map of neighborhoods in Tampa (City of Tampa, 2010), the sample appears to provide decent coverage of the City's neighborhoods. The empty area at the south of the sample map is comprised of water and Macdill Airforce Base, while the empty area to the east is the location of Tampa International Airport. The sample is at a lower density of concentration in the less densely populated New Tampa area at the north of the sample map.

There are many possible sources of error in sampling design and execution (Champ 2003; Fink, 1995), all of which can influence the outcome and validity of the entire study. Most samples have some degree of bias (Fink, 1995). Great care was taken in this study to avoid these errors and correct for them where they are unavoidable to ensure the validity of this study.

The first source of error is coverage error, which occurs when the sample frame does not correspond with the population of interest. The population must be clearly defined and should be based on those who receive benefits from the environmental good in question (Champ, 2003). As most contingent valuation studies aggregate individual WTP values obtained from the sample to obtain a total valuation of the good for the

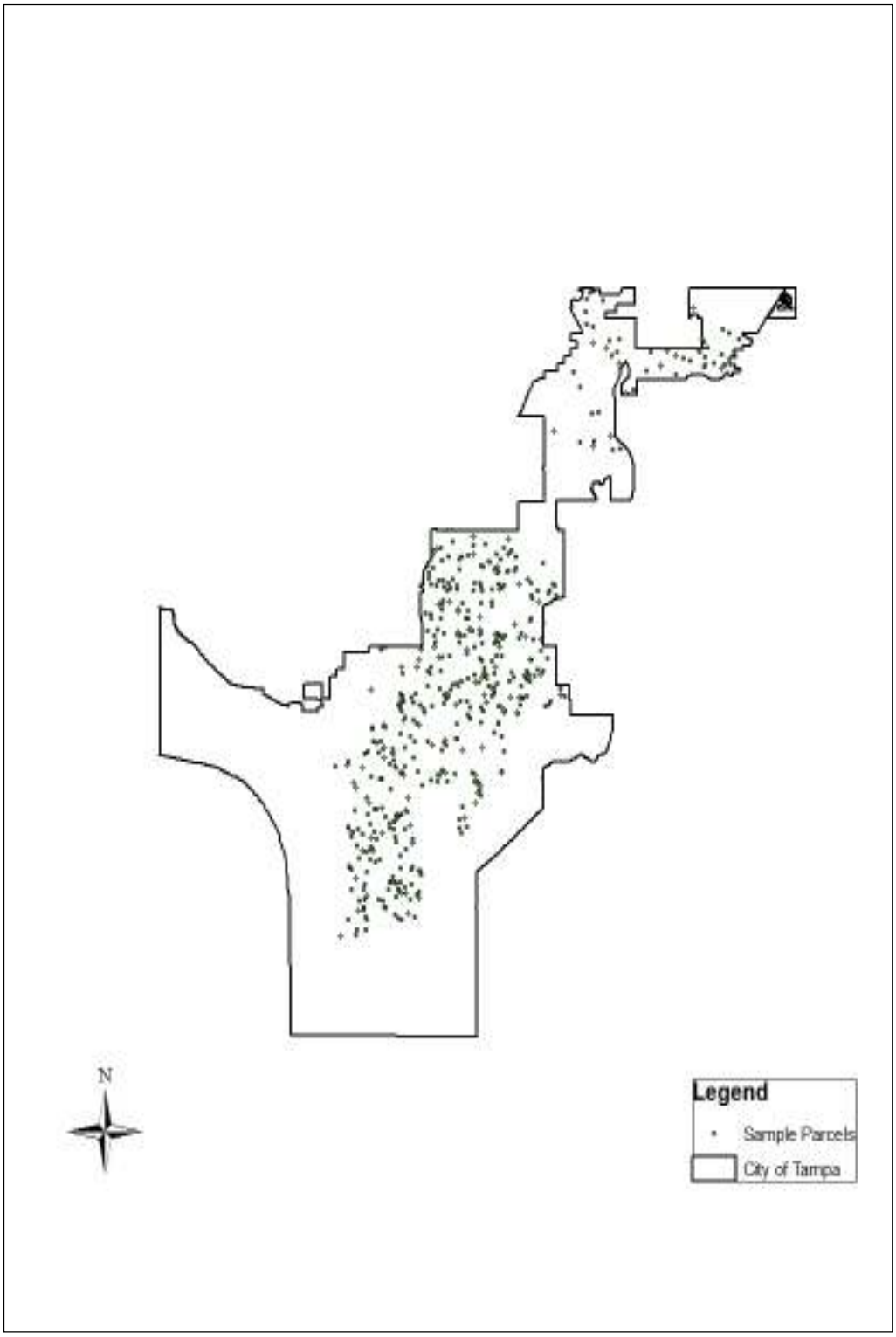

Figure 2: Spatial Distribution of Sample within the City of Tampa

population, the choice of the population will affect the magnitude of the total valuation obtained for the environmental good in question (Carson, 2000). This is a difficult issue, especially when attempting to measure existence, or non-use values. Some resources have benefits that extend far beyond their geographical bounds, such as the Grand Canyon. Anyone who values its existence, even if she or he has never been there or do not reside in its vicinity, derives utility from its existence. Likewise, visitors to Tampa can derive utility from its urban forest resource, even though they do not live within city or county limits. The carbon storage and sequestration provided by Tampa's urban forest is another benefit that extends beyond the City, due to the global nature of climate change issues. Unfortunately measuring this utility garnered by non-residents is not within the scope of this study. The population is defined as residents of the City of Tampa. Travel cost valuation methodology could be used to capture some of the utility of non-residents when they visit forested parks or recreational areas, and hedonic price valuation could be used to measure some of the utility gained by non-residents when they stay in hotels or other forms of temporary lodging. These issues must by necessity be left for subsequent studies.

Another source of error, non-response error, occurs when there are differences between actual survey respondents and the sampling frame. This is only an issue when those who respond to the survey are systematically different than those who do not respond (Fink, 1995; Dillman, 2007). If females hold different values for Tampa's urban forest than males and a larger percentage of females respond than are actually represented in the city's population, this would introduce error into the study's results.

The NOAA guidelines question the validity of any contingent valuation study with a low response rate (NOAA, 1993). No criteria for an acceptable response rate are given, and the report acknowledges that even the best surveys can have non-response rates of over 20 percent (NOAA, 1993). Different authors give different reasonable levels of response rates: Whitehead estimates that well constructed mail surveys can expect to yield response rates of 40-70 percent (Whitehead, 2006), and Mitchell and Carson say that mail surveys following Dillman's Tailored Design Method (TDM) can reasonably expect to garner 60 percent response rates (Mitchell and Carson, 1989). Recent contingent valuation studies of urban forest resources have garnered response rates ranging from 22 to 91 percent, with the average among the six studies being 47 percent. These figures are presented in Table 3. Other fields, such as transportation research, commonly achieve response rates between twenty and thirty percent (Paez and Whalen, 2010), and the American Association for Public Opinion Research has recently warned about dismissing research simply due to low response rates (American Association for Public Research, 2010).

Table 3: Response Rates of Recent CV Studies of Urban Forests

Study	Site	Execution Method	Response Rate %
Vesely 2007	New Zealand	In-person	63
Tyrvainen 2001	Finland	Mail	68, 40
Dwyer et al. 1989	Chicago	Mail	44
Chen et al. 2006	Hangzhou, China	In-person	91
Lorenzo et al. 2000	Mandeville, LA	Mail	22
Kwak et al. 2003	Seoul, Korea	In-person	Unknown
Treiman and Gartner, 2006	Missouri	Mail	40

Schneeman (1997) conducted a meta-analysis of mail contingent valuation surveys focusing on response rates. Over one hundred and thirty surveys were analyzed using multiple regression and other statistical techniques to determine how various factors affected response rates, including standard survey features as well as features specific to contingent valuation scenarios. Four standard survey features were found to effect response rates: sponsorship, type of population, follow-ups, and postage. Contingent valuation surveys sponsored by government or universities were found to have higher response rates than those sponsored by marketing research firms (Schneeman, 1997). General populations were found to have lower response rates than specialized populations, such as on-site CV studies where solely users of a resource comprised the survey population, unfortunately this negative factor affecting response rates could not be avoided for this study.

Follow-ups and postage other than bulk class mail were found to increase response rates. Regular postage stamps and follow-ups are used in this study, as will be discussed in greater detail later. Contingent valuation features that were found to have a positive effect on response rates included: resource valued, elicitation method, cost of living, and information. Contingent valuation surveys regarding hunting and angling achieved higher response rates than surveys valuing other natural resources, possibly because these topics carried greater salience for the general public. Dichotomous choice as an elicitation method had a positive effect on response rates, holding all other factors equal, and as mentioned previously was the elicitation method used in this study. Cost of living was found to be the payment vehicle with a significantly positive effect on response rates, and it was considered as a possible payment vehicle for this study.

Information regarding substitutes for the resource being valued was found to positively affect response rates, and is also another contingent valuation feature that has been discussed previously and is a component of this study. Schneeman's (1997) study was conducted as an attempt to show how mail contingent valuation studies could achieve acceptable response rates in a response to the NOAA guideline's endorsement of in-person interviews as the sole appropriate method to conduct CV studies (NOAA, 1993). As much as possible, her findings were used to conduct a mail contingent valuation survey that achieves acceptable response rates.

Dillman (2007) refined his Total Design Method into a Tailored Design Method, recognizing that an approach directed toward the survey population and content rather than a one size fits all approach could garner a higher response rate. Different empirically tested methods of achieving a higher response rate are combined in this method to create a survey process that achieves the highest possible response rate, addressing all aspects of surveying, including sampling, question writing, graphic presentation, points of contact, and survey analysis. All possible efforts were made to follow this widely respected methodology, given the technical, temporal, and financial constraints imposed upon this study. One of the best methods of increasing the response rate of a contingent valuation survey is to make the survey meaningful to respondents and show that responding can be beneficial to them (Champ and Welsh, 2007; Dillman, 2007). This can be accomplished by explaining the importance of the study and clearly explaining which group of policymakers will be presented with the results and what they will do with them. This method also served to reduce hypothetical bias, as respondents will be less likely to inflate or deflate the values that they attribute to an environmental resource if they

believe that those values will be considered in the distribution of said resource (Harrison, 2007).

Another of the most powerful ways to increase the response rate of a mail survey is to include follow-ups as part of the survey design (Dillman, 2007; Whitehead, 2006). It is important to plan these ahead of time and establish a set schedule, rather than conduct follow-ups as a desperation attempt when a low response rate is initially received. Follow-ups increase the cost of a mailed survey, but are essential to achieving a respectable response rate without a captive audience. Repeated contacts are also used in interview, internet, and phone surveys to increase response rates (Dillman, 2007).

Dillman (2007) recommends a system of five contacts, with the last being specialized either by telephone or some sort of special mail delivery. While this methodology has been built upon decades of tested and published research in social surveying, it is slightly ambitious for the temporal and financial constraints imposed by this study. Instead, two contacts were used to maximize response rate in this study. The first of these was the questionnaire mailing that includes a detailed cover letter explaining why the respondent's opinion is important. A week after the initial mailing, a thank you postcard was sent out to the entire sample. This postcard thanked respondents and requested that those who have not responded do so soon. Each of these mailing was carefully tailored and designed to achieve the highest response rate.

Another of Dillman's (2007) methods of increasing response rate has been endorsed within the contingent valuation literature (Whitehead, 2006). This involves the personalization of all mailings. While this method does not achieve as great of an effect as salience and repeated contact, it can still serve to increase the response rate of a mailed

survey (Dillman, 2007). All mailings are addressed to the individual survey respondent rather than “resident”, or “dear mr/mrs smith”. Another facet of personalization involves the signing, in pen, of the cover letters included in the first and third mailing. Personalization serves to show respondents that they are dealing with a real person, rather than a computer or a giant research firm or government agency (Dillman, 2007). These methods were followed in this study, as mail merge functions were utilized to personally address all correspondence and cover letters were signed in hand.

Another factor that can influence response rates is the level of information provided in the construction of the hypothetical market scenario (Hoevenagel and Van Der Linden, 1993). Providing the appropriate level of information allows respondents to be confident that they can make an informed choice about the provision of the resource in question by reducing any uncertainty they might have regarding the effects of their hypothetical consumption decision. This was accomplished in this study by informing respondents of the current amount of trees in Tampa as well as the additional amount that would be generated if the hypothetical ballot proposal was passed.

Every effort was made to reduce non-response error. Some survey literature calls for the seeking of funding to compensate participants (Schuman, 1996), which can often result in a higher response rate (Fink, 1995; Dillman, 2007), but others have suggested that paying for the completions of surveys removes the hypothetical nature of the contingent valuation exercise and can influence the level of willingness to pay expressed by respondents (Harrison, 2007). For this reason, other methods mentioned previously were used in attempts to achieve an acceptable response rate.

Survey Execution

The two options for survey execution considered by this study were face-to-face interviews and mailed surveys. Although internet surveys are gaining in popularity (Dillman, 2007) and telephone surveys are still frequently conducted, coverage problems inherent in these two methods of execution removed them from serious consideration. The NOAA guidelines (NOAA, 1993) as well as Mitchell and Carson (1989) call for contingent valuation surveys to be executed by face-to-face interviews. Others argue that each method of survey execution has its advantages and disadvantages, with different modes being more appropriate for different applications of the contingent valuation methodology (Schuman, 1996). One of the main reasons for the NOAA Panel and Mitchell and Carson's recommendation is that mail surveys are typically based on lists that omit a large percentage of the population in question (NOAA, 1993; Mitchell and Carson, 1989). Mail surveys also have difficulty controlling question-order effects as well as difficulty guaranteeing random selection within a household or even a single household member as a respondent (NOAA, 1993). In-person interviewing guarantees that the person chosen to respond to the survey is the one who actually does respond (Champ and Welsh, 2007). Another issue with mailed surveys is that those who are most emotionally or financially invested in the issue from one side or the other are more likely to respond to the survey, possibly leading to biased results (NOAA, 1993). This is because possible mail survey respondents are able to examine the entire survey before deciding if they will respond to it, something generally avoided in personal interviews (Schuman, 1996). Face-to-face surveying allows a study to reach those who would not

respond to mail, telephone, or internet surveys (Champ, 2003). Reading comprehension is also another difficult issue when constructing mail surveys, given the complexity of contingent valuation scenarios as well as the low reading comprehension levels of many potential respondents (Mitchell and Carson, 1989; Schuman, 1996). Face-to-face interviews allow for explanation by the interviewer of the hypothetical valuation scenario so that full understanding of the scenario can enable a valuation by the respondent of the actual resource change in question (Boyle, 2003). The inclusion of maps or other graphics is also facilitated by the use of either in person or mail surveys (Champ and Welsh, 2007). Face-to-face interviews also hold a temporal advantage over mail surveys, in that mail surveys take several months to execute properly, while in-person interviews can be completed within a month (Whitehead, 2006).

The main advantage of mail surveys is financial. It has been estimated that face-to-face contingent valuation surveys cost as much as twice the amount to administer per survey than mail surveys (Boyle, 2003). This is probably the reason why mail surveys are the most common mode of survey execution (Champ, 2003; Champ and Welsh, 2007). Another advantage of mail surveys is that respondents can take their time in answering the questions. This can be a benefit when considering the difficult valuation question, along with the privacy given by a mail survey to answer these sensitive questions (Whitehead, 2006; Schuman, 1996). Mail surveys can also be compared favorably to in-person surveys when considering that while there are parts of most cities that interviewers will refrain from entering for safety reasons; mail surveys are able to reach these areas without problems (Schulze et al., 1996). This possible source of non-coverage error could lead to biased results when conducting in-person contingent valuation studies.

Social desirability bias or the "warm glow" effect is also a disadvantage encountered when using face to face interviews as the mode of survey administration (Champ and Welsh, 2007; Schuman, 1996). Although these effects can be present in any contingent valuation study, the lack of anonyminity inherent in personal interviews makes the likelihood for them to be greater when conducting a study with that mode of survey execution (Champ and Welsh, 2007; Schuman, 1996). Research conducted on this topic shows signs that in-person interviews might result in higher WTP values than mail surveys (Maguire, 2009).

Another issue to be addressed when conducting in-person surveys that has not received a great amount of attention in contingent valuation literature is the appearance of the interviewer (Bateman and Mawby, 2004). The level of esteem that an interviewer is held in can be increased by increasing the professionalism of his or her appearance, although this effect might work in reverse when valuing alternative goods or sampling in different populations (Bateman and Mawby, 2004). There are several possible ways that interviewer appearance can affect the results of a contingent valuation survey. The first of these is incentive compatibility, as an interviewer with a more professional appearance can influence respondents' perceptions that the change in provision of the environmental resource in question can be executed (Bateman and Mawby, 2004). The previously mentioned level of esteem that the interviewer is held in by the respondent may also result in a greater value being attributed to the resource in question by respondents due to an increase in social desirability bias (Bateman and Mawby, 2004). Another issue is that interviewers may be subconsciously affected by the state of their appearance and that this effect can change their interviewing behavior and thusly change the results of the

contingent valuation survey (Bateman and Mawby, 2004). The best way to control the possible effects of interviewer appearance is the use of professional but not overly professional appearing interviewers, whose appearance is investigated by focus groups and cognitive interviews, although this is not an issue for this contingent valuation study.

Another type of interviewer affect that has not received a great amount of attention in the literature is affiliation. This refers to the concept that the origin of the study may suggest to the respondents the desired response to the willingness to pay or other questions (Leggett et al., 2003). For example, a contingent valuation survey evaluating the value attributed to Tampa's urban forest resource conducted by an environmental group dedicated to forest preservation might suggest to respondents that a positive value for the forest resource was desired by the interviewer or researchers. Similar to other forms of social desirability bias, this effect has been theorized to be greater when executing studies using in-person interviews, yet also present to a lesser degree in other modes of survey execution (Leggett et al., 2003). The affiliation effect was probably not an issue in this study, as the University of South Florida has no correlation with urban forests in the perceptions of respondents. One issue that remains is the possibility of a perception by respondents that the fact that a study is being conducted about an environmental resource signifies that there should be a value attributed to it. While this is an issue that can be addressed through question wording and reminders of substitutes and budget constraints, it remains as another reason why estimations garnered from contingent valuation studies should be evaluated conservatively.

Mail surveying has also been the predominant methodology for recent contingent valuation of forests in the United States and Europe (Lockwood and Tracy 1995; Dwyer

et al., 1989; Tyrvainen, 2000; and Treiman and Gartner, 2006). Each mode of survey execution has inherent advantages and disadvantages, yet mail surveying is chosen as the mode of survey execution for this study due to financial constraints as well as an attempt to avoid the presence of interviewer effects.

Data Analysis

All survey responses were coded with an identification number to ensure that names and addresses were kept confidential. This also eased the process of data verification (Champ, 2003; Whitehead, 2006). The surveys were pre-coded as much as possible to ease data entry and analysis. Data were entered twice and checked to ensure its veracity.

An important issue in data analysis of contingent valuation for which there exists no widely accepted standards is the treatment of protest bids. Protest bids are valuations where respondents give a value for a resource that is different from their true valuation (Haddad and Howarth, 2006). This can occur for several different reasons, including: rejection of the contingent valuation exercise itself (resulting from an idea along the lines of: it is unethical to place a value upon nature, or something similar), rejection of the payment vehicle (we already pay too much in taxes), strategic behavior of over or under-valuing a resource to achieve a desired effect, and people whose lack of understanding in the scenario causes them to give a value that is different than their actual utility (Boyle, 2003). This is one of the reasons why the valuation question should be followed up with a question seeking the reason for the valuation given by respondents. This can allow for the

categorization of protest bids, which often make up five to ten percent of responses, but can range up to fifty percent (Haddad and Howarth, 2006). The ex ante methodology for dealing with protest responses is to design a survey that minimizes them (Haddad and Howarth, 2006). This can be done by pilot testing and focus group work that leads to the most understandable, plausible, and meaningful valuation scenario, payment vehicle, and payment rule. The greater the incentive compatibility of survey, the lower the number of protest bids (Harrison, 2007). There is no set post ante method for dealing with protest responses. Some have advocated for their removal, as they can bias valuation estimates upward or downward (Mitchell and Carson, 1989). This is a daunting task, as protest bids may be hard to identify (Boyle, 2003). Another methodology counts protest bids as "true zero" bids, thusly establishing a lower bound for WTP estimates, as those who protested held some value for the resource in question (Leggett et al, 2003). A third technique involves the imputation of protest bids contingent upon their prediction by a statistical model (Carson and Hanemann, 2005). For the purposes of this study, valuation estimates were constructed with protest bids counting as "true zeros", to establish a conservative estimate for WTP and avoid biases involved in the identification and classification of protest bids. All possible effort were made in all facets of survey design to minimize the existence of protest bids

While every attempt was made to obtain a sample that is representative of the City of Tampa, if this can not be achieved, sample weights could be applied so that generalizations can be made (Champ, 2003). This can help to avoid the problem of non-response bias, as different types of respondents often have different response rates as well as different values for many environmental goods (Mitchell and Carson, 1989). If

segments of Tampa's population that hold different values for their urban forest than those who respond to the survey are excluded, the estimates garnered will be biased (either positively or negatively). One way to reduce this bias if a representational sample is not obtained is the procedure of sample weighting (Mitchell and Carson, 1989; Schuman, 1996; Whitehead, 2006; Carson and Hanemann, 2005; Carson, 2000). This involves establishing relative weights for underrepresented categories greater than one, and relative weights for overrepresented categories of less than one, so that each category is given a representation in WTP calculations equal to its representation in the relevant population (Mitchell and Carson, 1989). These techniques are based upon the assumption that those who do not respond have similar WTP values to respondents with similar characteristics (Mitchell and Carson, 1989). This assumption was not made, as it has been challenged (Schuman, 1996).

Another option for dealing with non-response that does not make any tenuous assumptions, simply involves setting non-respondent WTP to zero and aggregating to estimate mean, median, and total WTP (Whitehead, 2006). As it is highly improbable that all non-respondents have a WTP of zero for the environmental resource in question, this technique would produce a lower bound estimate for WTP. This might be somewhat advantageous, as conservative estimates are recommended by the NOAA guidelines (NOAA, 1993), and conservative estimates might hold more sway with policy makers unused to considering the economic value of environmental non-marketed goods. The other conservative approaches in this study to produce a lower bound estimate for WTP make this technique not necessary.

Now that unit non-response has been addressed, it is time to turn to item non-response. This can be as serious of an issue in contingent valuation studies as unit non-response (Whitehead, 2006). This issue is that when respondents do not respond to some items, each regression model run has a different number of variables, a situation known as incomplete case analysis (Whitehead, 2006). This makes it impossible to compare the models, as they are not equivalent (Whitehead, 2006). Like unit non-response, the best ex ante method to eliminate item non-response is to develop quality surveys that are refined through cognitive interviews, focus groups, and pilot tests (Mitchell and Carson, 1989). This can help to ensure that all questions are answered by all respondents.

There are several ex post methods for handling item non-response and conducting complete case analysis. The simplest is to simply drop all of the units with missing variables (Whitehead, 2006). The possible problem associated with this methodological technique is a large number of units may be lost, greatly reducing sample size (Whitehead, 2006). This can cause a loss of information provided by respondents. It is also a major issue for the validity of the entire valuation study, as the problems with low response rates have been addressed in detail previously. As mentioned, the NOAA guidelines question the validity of any study without a high response rate (NOAA, 1993).

Data imputation is the other ex post method of dealing with item non-response. This involves creating values for the missing variables so that no units of observation are lost. One approach to data imputation is to develop ad hoc imputation classes, such as elderly white males, and assign values in the missing cases based upon the valid values given in the class. These values can be the mean, median, or a randomly assigned value from the pool of valid observations for the class (Mitchell and Carson, 1989). The most

sophisticated method for data imputation involves running regression models and creating values for missing variables that are conditional upon other significant variables (Whitehead, 2006). This is the approach that was taken as data imputation was necessary to evaluate the results in this study. Nine cases had missing values spread throughout five different demographic variables. Three cases were missing values for gender, three for age, four for ethnicity, three for education, and five for income.

While data imputation is the ex post method of choice for dealing with item non-response in contingent valuation studies (Whitehead 2006; Carson and Hanemann, 2005; Mitchell and Carson, 1989), it is important to ensure that it does not affect your WTP results. There are two main methods for assessing the effect of data imputation on WTP values (Whitehead, 2006). The first of these is to create a second variable for every variable that has a significant number of imputed variables and run regression models with both variables. If the results from the two models are not significantly different, data imputation is not a concern (Whitehead, 2006). The second method involves the creation of dummy variables for any variables with significant amounts of imputed values. If the dummy variables contain insignificant coefficients, imputation did not significantly affect the results (Whitehead, 2006). A dummy variable was created to identify cases with imputed values that was included in later regression runs to determine if imputing values had a statistically significant affect upon the model. The dummy variable was not statistically significant in any regression runs, in models with it as a sole covariate upon respondent voting choice and in models with many different demographic covariates.

Every effort in survey construction was applied to reduce unit and item non-response. As data imputation is necessary, it was applied very cautiously, using the most

sophisticated methods available. Analysis of the effects of imputation was conducted, as imputation was a necessary component of this study.

Total willingness to pay as well as the lower bound of WTP for the increase of Tampa's urban forest resource by 250,000 trees in the hypothetical scenario was estimated. Point estimates as well as confidence intervals at the ninety-five percent level of confidence were developed for these valuation estimates, providing a richer portrait of preferences than point estimates alone (Mitchell and Carson, 1989). There are several options for the derivation of these point estimates, including parametric, semi-parametric and non-parametric approaches (Boyle, 2003). The non-parametric approach of the Turnbull distribution free estimator was chosen to develop estimates for willingness to pay. The first use of this technique in contingent valuation was by Carson, Hanemann, et al. in 1994 (Haab and McConnell, 2002), and Vesely's (2007) study discussed in the literature review used the method (along with other parametric techniques) to estimate WTP for urban forests in New Zealand. This non-parametric technique makes no assumptions about the distribution of WTP, reducing potential for bias due to misspecification. These estimates were made even more conservative by treating don't know/no answer responses to the valuation question as no responses, as these type of responses are traditionally treated in the literature (Alberini et al., 2003). Don't know responses might be the result of poorly formed preferences surrounding the good in question and might be made by those who actually value urban forests, but research has suggested that a large percentage of these responses are from those who are uninterested in the environmental good in question or the survey itself (Mitchell and Carson, 1989). The other option would be to exclude them from the analysis, which would greatly

reduce sample size and eliminate the opportunity to not participate given in actual ballot proposal issues.

The demographic and attitudinal information gathered was evaluated to determine any correlation between these variables and willingness to pay. This correlation is determined through cross-tabulations analysis (Mitchell and Carson, 1989; Carson and Hanemann, 2005; Carson, 2000; Whitehead, 2006). This can help to establish the construct validity of this study, as demographic and preference variables are expected to have a correlation to WTP under standard economic theory (Hoevenagel, 1994). For example, it is expected that WTP will correlate positively with income, membership in environmental groups, and prior knowledge or use of the environmental resource in question. The size and sign of the estimated cross-tabulations were then compared with those predicted by economic theory to provide validity to the study in question. This establishment of construct validity can ease the acceptance of a study's findings by policymakers and help to ensure that the findings of such a study are considered in the decision making process. While this type of analysis has upheld the construct validity of many contingent valuation studies, it is important to remember that the theory or model is being tested as well as the survey instrument when considering construct validity (Hoevenagel, 1994; Carson and Hanemann, 2005).

Reporting

The NOAA guidelines call for exactitude and expansiveness in reporting on contingent valuation studies. "Every report of a CV study should make clear the

definition of the population sampled, the sampling frame used, the overall sample non-response and its components (e.g., refusals), and item-non-response on all important questions (NOAA, 1993, p 4612).” The majority of reports on contingent valuation of urban forest resources in scholarly journals meet the first three of these conditions, and the fourth condition is irrelevant, as uncompleted surveys are generally counted as non-responses (Chen et al., 2006, Tyrvainen, 2001). Very few studies meet the next condition, the inclusion of the questionnaire in its entirety as well as any other correspondence with respondents. While this may be an issue of space in many scholarly publications, it follows that the survey is a necessary component of evaluation of a contingent valuation study. Most studies include just the valuation question (Lockwood and Tracy, 1995), while some also include an exact description of the hypothetical market scenario from the questionnaire (Tyrvainen, 2001; Treiman and Gartner, 2006). The guidelines also call for the archiving of all data to be made available to interested parties. The reporting of this study follows the NOAA guidelines in their entirety, so that the study and its validity and reliability can be evaluated and so that as much information can be gleaned from it as possible, both for assessment of policy and the advancement of contingent valuation methodology.

Conclusion

A methodology was developed for designing, executing, evaluating, and reporting on a contingent valuation study of the City of Tampa’s urban forest resource. This methodology was largely based upon the guidelines of a panel established by the

National Oceanic and Atmospheric Administration to evaluate contingent valuations (NOAA, 1993). Other evaluations of the valuation technique as well as previous studies and the vast field of survey literature also figured into methodology development. The methodology outlines the procedure for all aspects of the valuation study: survey design, pilot testing, sampling, survey execution, collection of other datasets, data analysis, and reporting. There is an inherent level of uncertainty in any contingent valuation study (Mitchell and Carson, 1989; Price, 2003; Blomquist and Whitehead, 1995). This uncertainty can be minimized by following best practices established by decades of applied research in the contingent valuation field.

The goal of this valuation study is to produce an estimation of the value associated with the City of Tampa's urban forest resource to better inform policymakers when making decisions concerning said resource. Many of the values associated with Tampa's urban forest have been quantified in the City of Tampa Urban Ecological Analysis (UEA) (Andreu et al., 2008). This study sought to measure the unquantified nonmarket benefits, include non-use or existence values as well as those already quantified by the UEA. The inclusion of more of the values that society receives from this resource can result in a more efficient distribution of it.

CHAPTER FOUR:

RESULTS

Introduction

Five hundred surveys were mailed out to the sample of selected Tampa residents over the age of 18 on May 15, 2010. Sixteen surveys, or 3.2 percent of the mailing list, were returned as undeliverable. This speaks to the quality of the cadastral data used to draw the sample, as professional sampling firms typically guarantee that only eighty percent of their addresses are valid (Whitehead, 2006). A reminder postcard was mailed out to the entire sample, minus the undeliverable addresses, two weeks later. The text of the reminder postcard can be found in Appendix One. A total of one hundred and seven completed surveys were returned from the two mailings, yielding a 21.4 percent response rate when defining response rate based upon the total number of surveys sent out. Defining response rate by the number of surveys that reached their intended destination (Whitehead, 2006), yields a response rate of 22.1 percent after undeliverable surveys were removed. Eighty four or 78.5 percent of these were respondents to the first mailing, while 23 or 21.5 percent were respondents to the second mailing. Seven respondents, or 1.4 percent of the sample, formally declined the survey. Table 4 shows the categories of respondents.

Table 4: Respondent Characteristics

Response Category	N	% of Sample	% of Respondents
Mailing List	500		
Respondents	107	21.4	
1st Mailing Responses	84	16.8	78.5
2nd Mailing Responses	23	4.6	21.5
Declined	7	1.4	
Undeliverable	16	3.2	

Figure 3 shows the spatial distribution of the categories of respondents. Similar to the sample map shown in figure 2, respondents were spread throughout the City of Tampa. The empty areas to the east and south of the map are comprised of Tampa International Airport and Macdill Air Force Base, respectively. The northern third of the map where respondents are more spread out is the less densely populated New Tampa area.

Comparison Between Two Mailings

As this study was comprised of two mailings, it is important to compare respondents from both and determine if the different mailings produced different demographic groups of respondents or different voting patterns. As previously mentioned, the first mailing produced 84 respondents and the second produced 23. Respondents from the two mailings were analyzed based on the demographic information obtained about their gender, age, ethnicity, income, and education. T-tests for equality of means were conducted for each demographic variable. Results are presented in Table 5..

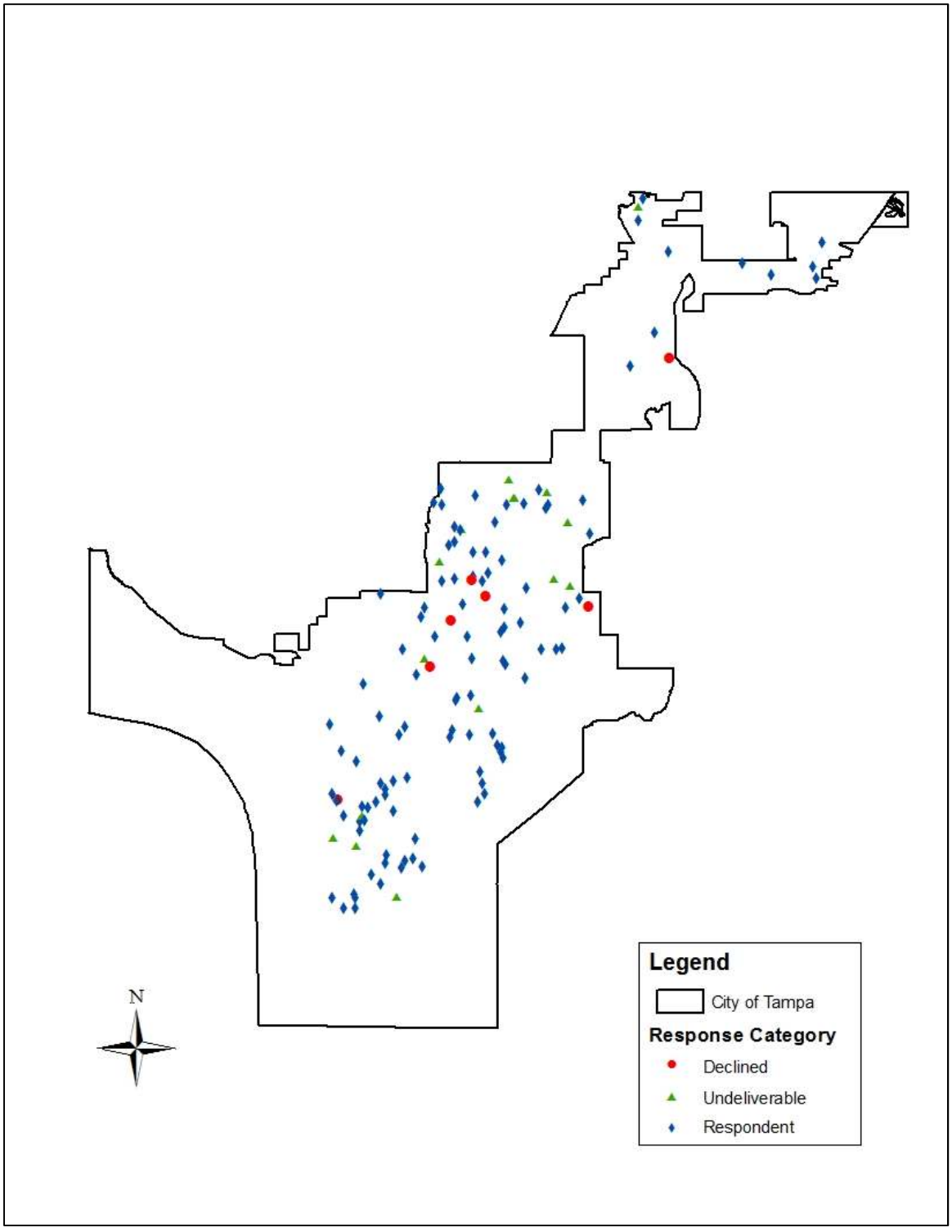

Figure 3: Spatial Distribution of Respondent Categories in Tampa

Only one demographic variable, percent Asian, allowed for rejection of the null hypothesis that the mean values from the two mailings were equal, with a p-value of .083. This allows the assumption that respondents did not differ significantly between the two mailings. The results of the hypothetical ballot measure were also compared between the two mailings. Examination showed that 63 percent voted for the increase in Tampa's urban forest provision in the first mailing and 61 percent in the second mailing, which t-tests for independence of means showed to be a statistically insignificant difference.

Demographics of Respondents

Table 6 details the demographic characteristics of respondents. Of the 107 respondents, 35 were male and 72 female, or 33 and 67 percent, respectively. The respondents showed ethnic variation, as 73 percent were Caucasian, 13 percent were African American, 9 percent Latin, 3 percent Asian, and 2 percent other. The "baby boomer" generation was the highest represented age group of respondents, with 43 percent being between the ages of 50-64. The next highest group was those aged between 36-49 at 22.4 percent, while those aged 65 and above comprised 18.7 percent of the respondents and 22 to 35 year olds 14 percent. Those aged 18 to 21 were slightly less than one percent of respondents, which could possibly be explained by the hypothesized homeowner sampling procedure. Personal income also showed variation, as 10.5 percent of respondents made less than $20,000 per year, 23.4 percent made between 20 and 40 thousand dollars per year, 21.5 percent made between 40 and 60 thousand dollars per year, 27.1 percent made between. 60 and 100 thousand dollars per year, and 18.7 percent of respondents made more than

Table Five: Comparison of Demographics between Mailings

Demographic Category	1st Mailing N	1st Mailing %	2nd Mailing N	2nd Mailing %	P Value
Total	84		23		
Male	29	34.5	6	26.1	
Female	55	65.5	17	73.9	0.436
Caucasian	62	73.8	16	69.6	0.688
African American	9	10.7	5	21.7	0.252
Latin	8	9.5	2	8.7	0.905
Asian	3	3.6	0	0	.083*
Other	2	2.4	0	0	0.46
18-21	1	1.2	0	0	0.603
22-35	13	15.5	2	8.7	0.352
36-49	21	25	3	13	0.172
50-64	33	39.3	13	56.5	0.142
65+	16	19	4	17.4	0.858
<20k	8	9.5	3	13	0.626
20-40k	21	25	4	17.4	0.45
40-60k	18	21.4	5	21.7	0.975
60-100k	22	26.2	7	30.4	0.688
>100k	16	19	4	17.4	0.858
Some High School	1	1.2	1	4.3	0.49
HS Diploma/GED	15	17.9	5	21.7	0.676
Some College	21	25	3	13	0.172
Bachelor's	28	33.3	7	30.4	0.795
Grad Degree	19	22.6	7	30.4	0.443
For Proposal	53	63	14	61	0.847

(*= significant at the p=.10 level)

$100,000 per year. A bachelor's degree was the most common level of educational attainment among respondents, at approximately 33 percent. Twenty four percent held graduate or professional degrees, while 22 percent had attended some college without obtaining a degree. Nineteen percent of respondents had a high school diploma or equivalency. Interestingly, several respondents scratched out the GED option or circled HS Diploma, showing how the desire to show social status is present even in mailed

surveys. Only two percent of respondents did not possess at least a HS Diploma or equivalency. Nine respondents, or 8.4 percent of the sample, were members of environmental groups. According to the most recent data found (based on surveys from 1999 to 2002), this is below the national average for environmental group membership of 15.9 percent (Dalton, 2005). Estimates of the rate of environmental group membership in the City of Tampa were not available for comparison.

Table 6: Demographic Characteristics of Respondents

Demographic Category	Respondent N	Respondent %
Total	107	
Male	35	32.7
Female	72	67.3
Caucasian	78	72.9
African American	14	13.1
Latin	10	9.3
Asian	3	2.8
Other	2	1.9
18-21	1	0.9
22-35	15	14
36-49	24	22.4
50-64	46	43
65+	20	18.7
<20k	11	10.5
20-40k	25	23.4
40-60k	23	21.5
60-100k	29	27.1
>100k	29	18.7
Some High School	2	1.9
HS Diploma/GED	20	18.7
Some College	24	22.4
Bachelor's	35	32.7
Grad Degree	26	24.3
Environmental Group Member	9	8.4

The survey also gathered information about where respondents grew up. This was based upon results from a previous survey that showed that this information could possibly be an important covariate upon willingness to pay for urban forest provision (Treiman and Gartner, 2006). The first demographic question, in an attempt to begin the demographic questions with a non-threatening question that would invite respondents to continue with the demographic section, asked respondents if they grew up in urban, suburban, small town, or rural environs. A don't know/no answer option was also provided. Results are presented in Table 7. Approximately a third of respondents belonged to both the urban and suburban categories, at 36.4 and 32.7 percent, respectively. Small town and rural origins accounted for 16.8 and 9.3 percent of respondents, respectively. The don't know/no answer option was chosen by 4.6 percent of respondents.

Table 7: Where Respondents Grew Up

Grew Up	N	%
Urban	39	36.4
Suburban	35	32.7
Small Town	18	16.8
Rural	10	9.3
Don't Know/No Answer	4	4.6

Comparison of Respondent Demographics with Tampa demographics

Table 8 shows a comparison of the demographic characteristics of the respondents with the demographic characteristics of all Tampa residents over the age of 18. The

estimates from the 2008 American Community Survey (ACS) for the City of Tampa were used for this analysis (US Census Bureau, 2008). The demographic categories used in the survey did not exactly match those reported by the ACS, so some interpretation was necessary. As the defined population for this study was Tampa residents over the age of 18, figures for Tampa are based upon the number of residents in each category that are above 18, except where noted as otherwise below. Racial data were not available by age, so numbers and percentage for Tampa are based upon the total number of residents (341,137). The racial categories also do not add up to 100 percent, as racial and ethnic questions were combined in the survey used by this study. This could possibly lead to some confounding results, as Latino residents are not included in ACS racial estimates but are included in the survey data from this study. The inclusion of all ages in the ACS racial and ethnic data could also lead to confounding results if proportions of these ethnicities are different between those aged over 18 and those below. Income comparisons between the two groups of data could also potentially be misleading, as the ACS does not provide per capita income data, while this is what was collected by the survey in this study. Personal income was the correct metric for this study, as the payment vehicle for the contingent valuation study was personal income tax, but unfortunately these data were not available. Household income was used as a proxy for personal income, with the number of households in Tampa being 135,555. Various demographic categories necessitated the combining of groups from ACS data.

Z-tests for proportion were conducted for each demographic variable. As previously mentioned, not all of the demographic categories were reflected in American Community Survey data, so proxies or surrogates were used. The race and ethnicity

comparison and Z-values are based upon using an N of 341,137 residents in the City of Tampa, and the income comparisons and Z-values are based upon the 135,555 households in the City of Tampa. Results from the Z-tests for proportion reveal some disparities between the sample and residents of the City of Tampa aged over 18, the population for this study. The difference in gender proportions were statistically significant at the p=.01 level, as the sample was approximately two thirds female while Tampa is split almost evenly between genders. African Americans and Latinos were under represented in the sample, with differences in proportions for both being statistically significant at the p=.01 level. As previously mentioned, the inclusion of race and ethnicity in the same question could have led to misrepresented proportions of Latinos in the sample. The proportion of Asians, other races, and Caucasians was not statistically significantly different between the sample and the City of Tampa. The two youngest age groups were under represented and the 36-64 age group was over represented, which makes sense, given the homeowner approach in drawing the sample. The 65+ age group did not show statistically significant differences in proportion between the sample and the City of Tampa.

The lowest income group of under $20,000 per year was under represented in the sample, with the difference in proportions being statistically significant at the p=.05 level. The $60,000 to $100,000 income bracket was over represented in the sample, with the difference in proportions being statistically significant at the p=.10 level. The other three income groups did not show a statistically significant difference in proportions between the sample and the City of Tampa. The lowest educational level, some high school, was under represented in the sample, and the two highest levels were over represented. All of

these educational differences in proportion were statistically significant at the p=.01 level. In summary, when compared to residents of the City of Tampa aged over 18, the sample contained more females, fewer minorities, fewer of those in the lowest income and education categories, and more of those in the higher income and education categories. This could be a concern if over or underrepresented groups hold different values towards Tampa's urban forest.

Table 8: Comparison of Respondent and Tampa Demographics

Demographic Category	Respondent N	Respondent %	Tampa N	Tampa %	Z-Value
Total	107		262,644		
Male	35	32.7	128,907	49.1	3.213***
Female	72	67.3	133,737	50.9	3.213***
Caucasian	78	72.9	227,034	66.6	1.217
African American	14	13.1	91,361	26.8	3.153***
Latin	10	9.3	74,918	22	3.129***
Asian	3	2.8	10,112	3.0	0.283
Other	2	1.9	5,280	1.5	0.345
18-21	1	0.9	17,174	6.5	2.112**
22-35	15	14	70,155	26.7	2.92***
36-64	70	65.4	138,967	52.9	2.39**
65+	20	18.7	36,348	13.8	1.053
<20k	11	10.5	28,625	21.1	2.42**
20-40k	25	23.4	31,956	23.6	0.129
40-60k	23	21.5	21,948	16.2	1.56
60-100k	29	27.1	26,398	19.5	1.688*
>100k	29	18.7	26,628	19.6	0.138
Some High School	2	1.9	22,458	10	2.597***
HS Diploma/GED	20	18.7	56,796	25.2	1.321
Some College	24	22.4	40,609	18	0.951
Bachelor's	35	32.7	44,319	19.7	3.24***
Grad Degree	26	24.3	28,675	12.7	3.238***

(*** p<.01, ** p<.05, * p<.10)

Attitudinal and Behavioral Responses

The attitudinal and behavioral data gathered by this study provide a wealth of information about Tampa residents' perceptions and attitudes towards their urban forest resource that can be compared and contrasted with information gathered from similar studies in Tampa and other places. This information could also be used to tailor urban forest activities to those most interested in them, or conversely to capture the interest of those least interested.

Several other community or urban forest studies have been performed across the United States and internationally. This includes both informational surveys and contingent valuation studies. It is informative to compare preference and attitudinal information obtained in these studies with the information garnered from this urban forest study in Tampa. These studies include those performed in: The largest metropolitan areas in the United States (Lohr et al., 2004); Knox County, Tennessee (Davis and Jones, 2006); Salo and Joensuu, Finland (Tyrvainen, 2001); Hangzhou, China (Chen et al., 2006); and Broward and Hillsborough Counties (Escobedo et al., 2009). It is important to note that these surveys are structured differently and some are tailored to different locations, which are two possible sources of difference between survey results other than differences in perceptions and attitudes between locations. Unfortunately not all contingent valuation surveys collect or publish this information (e.g., Treiman and Gartner, 2006; Kwak et al., 2003) that can provide valuable information about urban forest perceptions in the study locations, provide for comparisons between locations, and help to explain how and why people attribute economic value to urban forests.

The first attitudinal question was intended to serve as a non-threatening warmup type question that would serve to interest respondents and entice them to continue further in completing the survey. It asked respondents if, in their neighborhood, they would like more trees, fewer trees, or if the current amount of trees was just right. A don't know/no answer option was also provided to respondents. Almost exactly half of respondents (53, or 49.5 percent) said that the current amount of trees in their neighborhood was just right. Four times as many of the remaining respondents said that they would like more trees than fewer trees (40 versus 10). The remaining 4, or 3.7 percent of respondents chose the don't know/no answer option.

The next four questions dealt with perceived environmental and community benefits and problems of Tampa's urban forest. Respondents were instructed to mark as many benefits or problems that they felt applied to each category, so the Ns do not add up to 107 and the percentages do not add up to 100. Respondents were also given an opportunity to write in other benefits, most of which were able to be reclassified into existing answers. None of the "true" other answers were present in sufficient numbers to allow for the creation of new categories of benefits or problems. Perceived benefits of Tampa's urban forest are displayed in Table 9. Aesthetics and shade were the two highest perceived benefits, at 93.5 and 89.7 percent respectively. The next three highest rated benefits were provides wildlife habitat, energy conservation, and reduces air pollution, at 72.9, 70.1, and 70.1 percent respectively. Sixty-seven respondents or 62.6 percent felt that privacy and increased property values were benefits provided by Tampa's urban forest.

Over half (59 or 55 percent) of the respondents perceived reduction of global warming as an environmental benefit of Tampa's urban forest, while slightly less than half (48.6, 43.9, and 41.1 percent respectively) perceived sound reduction, stormwater management, and recreation as urban forest benefits in Tampa. Public safety was the lowest rated benefit, with only 6, or 5.6 percent of respondents rating it as a community benefit of Tampa's urban forest. Some respondents chose not to answer the two questions about urban forest benefits in Tampa, with 1.9 percent and 6.5 percent respectively choosing the don't know/no answer option when answering the question about community and environmental benefits. Incredibly, zero respondents replied that Tampa's urban forest provided no community or environmental benefits!

This is similar to results obtained in Knox County, Tennessee, where air quality, wildlife habitat, and privacy were the top three rated benefits of urban forests (Davis and Jones, 2006), although 94 percent of their sample felt that urban trees increased property values, compared to 62.6 percent in Tampa. Escobedo et al. (2009) surveyed homeowner association (HOA) leaders in Hillsborough and Broward counties. Results from these studies were also compared to a national survey conducted by Lohr et al. (2004) that sampled the 112 largest metropolitan areas in the contiguous United States. Results from HOA leaders in both Hillsborough and Broward counties were similar to those conducted to this study, as aesthetics and shade were the top two benefits identified by respondents in each county. The national study also had shade as the highest rated urban forest benefit, although "makes people feel calmer" was the second rated benefit (Lohr et al., 2004). Interestingly, aesthetics and shade were also the top two rated benefits in a study performed in Hangzhou, China (Chen et al., 2006).

Table 9: Benefits of Tampa's Urban Forest

Community Benefit	**N**	**%**
Aesthetics	100	93.5
Recreation	44	41.1
Property Values	67	62.6
Shade	96	89.7
Sound Reduction	52	48.6
Public Safety	6	5.6
Privacy	67	62.6
No Benefits	0	0
Don't Know/No Answer	2	1.9
Environmental Benefit	**N**	**%**
Stormwater Management	47	43.9
Reduces Air Pollution	75	70.1
Reduces Global Warming	59	55.1
Energy Conservation	76	70.1
Wildlife Habitat	78	72.9
No Benefits	0	0
Don't Know/No Answer	7	6.5

The problems that respondents perceived as associated with Tampa's urban forest are shown in Table 10. Root damage and pollen/allergies were the two problems cited the most by respondents, at 58.9 and 55.1 percent, respectively. The other problem cited by more than half of respondents was sidewalk damage from roots, at 53.3 percent. Hurricane damage, downed limbs, the cost of tree care, and the unsightliness of poorly managed trees were the four next highest cited urban forest problems by respondents, at 49.5, 45.8, 44.9, and 43 percent, respectively. Blocks signage and the cost of leaf removal were the two next highest cited problems, at 35.5 and 29 percent, respectively. The two lowest rated problems were increased insurance and fire, at 13.1 and 8.4 percent, respectively. Some respondents chose the don't know/no answer option for each question, with 5.6 and 1.9 responding in that manner for community and environmental

problems, respectively. The same number of respondents (12, or 11.2 percent) replied that there were no community or environmental problems associated with Tampa's urban forest. One might assume that these were the same 12 people who felt like there were simply no problems with Tampa's urban forest, but of the 24 no problems responses from the two categories only five cases (or 10 responses) said that there were both no community and environmental problems.

The survey of HOA leaders in Hillsborough and Broward Counties rated hurricane damage, falling branches, and root damage as the top three problems associated with urban forests (Escobedo et al., 2009). This is similar to results from this study, although pollen/allergies was not rated as a major problem in the Escobedo et al. studies, it was in this study. Lohr et al.'s national study rated pollen/allergies as the top urban forest problem and root damage as the third, but the second was blocks signage, which is only a minor concern among respondents to this study. The Hangzhou study also rated allergies, falling limbs, and root damage as the top three problems associated with urban forests (Chen et al., 2006). While the similarities between urban forest preferences in different regions and countries is striking, it is important to note that different cultures do have different attitudes and beliefs towards urban forests. This is clearly illustrated by Tyrvainen's 2001 contingent valuation study in Finland where over half of the respondents stated that urban forests caused no negative effects in the study area (Tyrvainen, 2001). The level of forest attributes present in areas and how well they are maintained can affect or supersede cultural traditions that influence urban forest perceptions (Brownlow, 2006).

Table 10: Problems Associated with Tampa's Urban Forest

Community Problem	**N**	**%**
Block Signage	38	35.5
Cost of Tree Care	48	44.9
Cost of Leaf Removal	31	29
Increased Insurance	14	13.1
Sidewalk Damage From Roots	57	53.3
Unsightliness of Poorly Managed Trees	46	43
No Problems	12	11.2
Don't Know/No Answer	6	5.6
Environmental Problem	**N**	**%**
Root Damage	63	58.9
Pollen/Allergies	59	55.1
Downed Limbs	49	45.8
Hurricane Damage	53	49.5
Fire	9	8.4
No Problems	12	11.2
Don't Know/No Answer	2	1.9

The next two questions dealt with knowledge about Tampa's urban forest. This is important for two reasons: first, as respondents are valuing a hypothetical improvement to Tampa's urban forest, economic theory requires them first to have knowledge of it equal to that in a typical consumer transaction (Mitchell and Carson, 1989); secondly according to theory, those who `hold more knowledge about an environmental resource should also attribute more value to it (Mitchell and Carson, 1989). Respondents were given a five point Likert scale with a don't know/no answer option. Results are presented in Table 11. Only 4.7 percent of respondents replied that they were very knowledgeable about Tampa's urban forest, while 38.3 percent were somewhat knowledgeable and 31.8 percent were very slightly knowledgeable. Only 20.6 percent of respondents were not knowledgeable at all about Tampa's urban forest, a low percentage that satisfies the prior knowledge requirements of economic theory. The second issue of importance with

knowledge levels of respondents, its effect upon values attributed to the resource in question, will be discussed later in the valuation section.

Table 11: Knowledge Level of Respondents

Knowledge Level	N	%
Very Knowledgeable	5	4.7
Somewhat Knowledgeable	41	38.3
Very Slightly Knowledgeable	34	31.8
Not Knowledgeable At All	22	20.6
Don't Know/No Answer	8	7.5

The next question explored where respondents obtained their knowledge of Tampa's urban forest. Respondents were instructed to mark all that apply, so the numbers do not add up to 107 and the percentages do not add up to 100 percent. Results are presented in Table 12. Television, the internet, and friends and family were the top three sources of urban forest information at 39.3, 38.3, and 35.5 percent, respectively. Books and home improvement stores were both information sources for 28 percent of respondents. Neighborhood/homeowner association and municipal government were the next two highest cited sources of information, at 21.5 and 19.6 percent, respectively. Extension service was the lowest rated source of information, with only 9.3 percent of respondents citing it as a source of urban forest information. Fifteen percent of respondents replied that they did not get any information about urban forests, while 5.6 percent chose the don't know/no answer option for this question. This is different from the results found by Escobedo et al. (2008), as they found the top six sources of urban forest information to be: newsletters, newspapers and magazines, the internet, landscaping specialists, friends, and extension agents. This disparity could be explained

by their sample being restricted to leaders in Homeowner Associations. Unfortunately other urban forest studies have not gathered or reported this information. The results from this question could serve to help information providers evaluate how effective they are in providing urban forest information to residents of the City of Tampa.

Table 12: Urban Forest Information Sources

Information Source	N	%
Television	42	39.3
Internet	41	38.3
Books	30	28
Extension Service	10	9.3
Friends & Family	38	35.5
City/County Government	21	19.6
Home Improvement Stores	30	28
Neighborhood/Homeowner Association	23	21.5
Don't Get Information	16	15
Don't Know/No Answer	6	5.6

The next question dealt with respondents' use of their urban forest resource. According to prevailing economic theory, those who use a resource more are more likely to be willing to pay for it (Mitchell and Carson, 1989). Also, those who value a resource but do not use it are expressing non-use, or existence values (Tietenberg, 2000). These concerns will be discussed later in the valuation section. The question was phrased as "How often do you visit areas with trees other than your own property". This does not precisely measure use of an urban forest resource, as it does not necessarily involve a choice to visit these areas, but after much deliberation and consultation with experts, it was chosen as the best possible use measure. Results are presented in Table 13. A large portion, 41.1 percent, or respondents visited areas with trees daily, 29 percent visited

weekly, and 10.3 percent visited monthly and yearly. Only 3.7 percent of respondents never visited areas without trees, while 5.6 percent chose the don't know/no answer option for this question.

Table 13: Urban Forest Use Frequency

Visit Frequency	N	%
Daily	44	41.1
Weekly	31	29
Monthly	11	10.3
Yearly	11	10.3
Never	4	3.7
Don't Know/No Answer	6	5.6

The next two survey questions asked respondents to rate the quality of trees in their neighborhood and then in the City of Tampa as a whole. These questions were intended to serve several purposes, the most obvious of which is to provide key decisionmakers in Tampa with an idea of how residents felt about urban forest provision and maintenance in their neighborhood and city. Responses could also be compared to voting decisions to help explain the values that respondents gave to improvements in their urban forest resource. Finally, these questions were also intended to start respondents thinking more deeply about how they perceived and valued their urban forest resources. A five point Likert scale with a don't know/no answer option was used for both questions. Results to these two questions are provided in Table 14.

Responses cluster in the middle of the Likert scale for both questions, with the vast majority of respondents stating that trees in their neighborhood and City were good or fair, and a small percentage stating that they were excellent or poor. This is especially true for Tampa, where only 3.7 percent of respondents stated that trees were excellent and only 5.6 percent that trees were poor. Regarding trees in their neighborhood, 15.9 percent

of respondents felt they were excellent and 10.3 percent that they were poor. The don't know/no answer option was chosen by 8.4 percent of respondents regarding Tampa and 3.7 percent of respondents regarding their neighborhood.

The low percentage of respondents choosing the poor option for the quality of trees in both their neighborhood and the City of Tampa as a whole is a very positive representation of the quality of trees in the City and speaks well of the job that both local agencies and private citizens have done maintaining trees in Tampa. Cross-tabulations were executed between respondent rating of trees in both their neighborhood and the City and the tree cover strata used to draw the sample. The tree cover strata were based upon percent tree canopy coverage at the block group level, which could be a good proxy for neighborhood tree coverage. The tree cover strata were divided in to two groups, high and low, with the division based upon the mean tree canopy coverage for the City. The only significant cross-tabulation was between those who rated trees in their neighborhood excellent and tree cover strata, which was significant at the p=.01 level. Those in the high tree cover strata were more likely to rate trees in their neighborhood excellent.

Table 14: Tree Quality in Respondents' Neighborhoods and Tampa

Quality of Trees in Tampa	N	%	Quality of Neighborhood Trees	N	%
Excellent	4	3.7	Excellent	17	15.9
Good	43	40.2	Good	49	45.8
Fair	45	42.1	Fair	26	24.3
Poor	6	5.6	Poor	11	10.3
Don't Know/No Answer	9	8.4	Don't Know/No Answer	4	3.7

The next question directly preceded the valuation question, serving an important purpose in the contingent valuation context. This was to remind respondents of

substitutes and complements to the environmental resource in question. This helps to place the hypothetical market decision on an equal footing with a real market decision where economic agents are fully informed and rational (NOAA, 1993; Mitchell and Carson, 1989). Respondents were asked if they felt that more of their tax money should be used to address: environmental problems, education, community assistance, healthcare, police, or prisons. Options of none of these uses for tax money and don't know/no answer were also presented to respondents. Respondents were instructed to mark all that apply, so the numbers do not add up to 107 and the percentages do not add up to 100. It is important to note that this question asked for a redistribution of current tax dollars rather than an additional tax amount, something that might have been unclear to respondents. Results are presented in Table 15. Over half of the respondents wanted to see more of their tax money directed towards education and environmental problems, at 52.4 and 50.5 percent, respectively. Healthcare, community assistance, and police were the three next highest categories respondents wished more taxed money directed towards, at 39.3, 34.6, and 28 percent apiece, respectively. Only 5.6 percent of respondents wished to direct more of their tax money to prisons. 13.1 percent of respondents chose the no more tax money for any of these uses option, indicating that they were happy with the present distribution of their tax money, or as noted earlier, possibly that they did not wish to pay any more taxes. The don't know/no answer option was chosen by 10.3 percent of respondents.

Table 15: Additional Uses for Tax Dollars

Tax Use	Yes N	Yes %	No N	No %
Environmental Problems	54	50.5	53	49.5
Education	56	52.3	51	47.7
Community Assistance	37	34.6	70	65.4
Healthcare	42	39.3	65	60.7
Police	30	28	77	72
Prisons	6	5.6	101	94.4
None	14	13.1	93	86.9
Don't Know/No Answer	11	10.3	96	89.7

Valuation Section

As discussed in the methodology section, the valuation question was phrased as "**If there was a ballot proposal for a one-time tax of x$ to increase Tampa's urban forest citywide, on all types of land uses by 250,000 trees of all types, would you vote for or against, remembering your household's expenses and budget constraints?**". A don't know option was also given to respondents, so that unsure respondents were not forced to make a decision, as advised by the NOAA Panel (NOAA, 1993). Of 107 respondents, 67, or 62.6 percent voted for the hypothetical ballot proposal at bid levels of 5, 7, and 9 dollars. Only 17 respondents, or 15.9 percent voted against the proposal, while 23 respondents, or 21.5 percent chose the don't know/no answer option. According to Mitchell and Carson (1989), a non-response or don't know/no answer response to the valuation question between 20 and 30 percent is not uncommon in contingent valuation surveys of the general public. Disaggregating the vote and examining it by bid level reveals some surprising results that are shown in Table 16. Most importantly, regardless of the bid level, the majority of respondents were willing to pay the specified additional

level of taxes to increase the provision of their urban forest resource. However, the number of respondents and votes for the proposal goes up in tandem with the bid level. This is somewhat counterintuitive, as the number of respondents willing to vote for a hypothetical ballot proposal (or purchase a real consumer good) should decline as the bid level (or price) increases. This is referred to in economics as monotonic preferences (Haab and McConnell, 2002). A possible explanation for this is the small price difference between bid levels along with the small number of respondents for each bid price. A greater difference in bid prices or a larger pool of respondents at each price might have revealed the expected monotonic preferences (Haab and McConnell, 2002). Another possible explanation is that the low bid level of $5 was perceived by respondents as unrealistic and not very efficacious in improving Tampa's urban forest, leading a lower proportion of respondents to vote for the proposal at this bid level (Haab and McConnell, 2002).

Table 16: Response by Bid Level

Bid Level	$5	$7	$9	Total
Total N	30	36	41	107
For N	15	22	30	67
For %	50	61.1	73.2	62.6
Against N	6	5	6	17
Against %	20	13.9	12.2	15.9
Don't Know/No Answer N	9	9	5	23
Don't Know/No Answer %	30	25	14.6	21.5

The proportion of respondents from different demographic groups and with different urban forest attitudes and perceptions who voted for the proposal was also calculated using cross-tabulations. This can provide comparison between different groups that can help to explain voting patterns, lead outreach efforts to those unsupportive of

urban forests, and possibly guide urban forest distribution to those areas where residents desire it the most. The results of these cross-tabulations are presented in Tables 17 (demographics) and 18 (attitudes). The statistical significance of these cross-tabulations was evaluated using chi-square analysis (Field, 2005), with two-tailed p-values included in the tables.

Respondents aged 36-49 voted for the hypothetical proposal at a higher proportion than any other age group, at 79.2 percent. This cross-tabulation was significant at the p=.1 level. As age groups increased from this level, the proportion voting for the proposal decreased, although the 36-49 age group was the only significant cross-tabulation of age groups and voting choice. This is similar to results found by Treiman and Gartner (2006), and may be due to their hypothesis that the long term nature of urban forest investments due to the timespans involved in tree growth and maturation may make such investments less reasonable to those towards the end of their lifespans. Elderly respondents might also have less disposable income to take on a new tax willingly. There was not a large disparity between genders and voting proportions (61.1 percent for males and 65.7 for males), similar to results from Treiman and Gartner (2006). The cross-tabulations for gender and voting choice were not statistically significant.

There was not a large difference between proportions voting for the proposal when looking at the different ethnic groups and no statistical significance found between ethnic groups and votes in the hypothetical valuation scenario. Caucasians were more likely to vote for the proposal (65.4 percent) than African Americans or Latinos (both 50 percent). This is contradictory to the previously discussed research by Alozie and

McNamara (2008), where Latinos in Phoenix were more willing than Caucasians to pay for public services. This discrepancy might be explained by geographical and resource differences or the small amount of Latinos in the current study. Cross-tabulations for ethnic groups and voting choice were not statistically significant.

Proportions voting for the proposal increased with both education and income, with those with graduate or professional degrees being the demographic group most likely to vote for the proposal (other than Asians, of which there where only three). The increased likelihood of those with graduate or professional degrees to vote for the proposal was statistically significant at the p=.05 level, while the decreased likelihood of those with some high school or high school diplomas or equivalencies was significant at the p=.10 level. The increased likelihood of those in the highest income bracket (over $100,000) to vote for the proposal was also significant at the p=.10 level. This is as expected and helps to validate the contingent valuation portion of this study, as those with higher incomes should be willing to pay more for environmental resources (Mitchell and Carson, 1989; Boyle, 2003). Other urban forest contingent valuation studies have found that increased income and education leads to a greater likelihood of being willing to pay for urban forest resources (Treiman and Gartner, 2006; Vesely, 2007; Lorenzo et al., 2000; Chen et al., 2006). Environmental group members were also highly likely to vote for the proposal, at 77.8 percent, although statistical significance was not found for this cross-tabulation..

Those who grew up in urban and suburban areas were more likely to vote for the urban forest proposal than those from small town or rural backgrounds, although these cross-tabulations were not found to be statistically significant. This is similar to results

from Treiman and Gartner (2006). One hypothesized reason for this pattern that they put forth is a greater reliance upon government assistance or intervention in urban/suburban areas compared to rural areas (Treiman and Gartner, 2006).

Table 17: Demographic Voting Patterns

Demographic Category	N in Category	% For Proposal	P-Value
Age 18-35	16	68.8	.727
Age 36-49	24	79.2	.057
Age 50-65	46	58.7	.467
Age 65+	20	50	.196
Male	35	61.1	.644
Female	72	65.7	.644
Caucasian	78	65.4	.332
African-American	14	50	.295
Latino	10	50	.386
Asian	3	100	.175
Other race/ethnicity	2	50	.710
Some High School	2	0	.065
HS Diploma/GED	20	45	.071
Some College	24	58.3	.622
Bachelor's	35	65.7	.644
Grad/Prof Degree	26	80.8	.028
Environmental Group Member	7	77.8	.326
Income <$20,000	11	45.5	.214
Income $20-40,000	25	60	.757
Income $40-60,000	23	56.5	.495
Income $60-100,000	29	65.5	.705
Income >$100,000	20	80	.075
Grew Up Urban	39	66.7	.512
Grew Up Suburban	35	68.6	.375
Grew Up Small Town	18	50	.225
Grew Up Rural	10	40	.121
Grew Up Dk/Na	5	80	.411

The attitudinal voting patterns generally serve to validate the results of the survey, as they proceed in a logical pattern. Of those who wanted more trees in their neighborhood, eighty percent voted for the proposal, while only 20 percent of those who wanted fewer trees did. These two cross-tabulations were significant at the p=.01 level. Slightly more than half (58.5 percent) of those who thought the current amount of trees in their neighborhood was just right voted for the proposal. Likelihood to vote for the proposal increased with frequency of visitation of areas with trees, the proxy for use in this study, although these likelihoods were not statistically significant. This helps to validate the contingent valuation portion of this study, as those who use an environmental resource should be more willing to pay for it than those who do not (Mitchell and Carson, 1989; Whitehead, 2006). For the most part, as respondent rating of urban forest resources in their neighborhood and the city as a whole decreased, respondent likelihood to vote for the proposal increased. The exception to this is that only 36.4 percent of the eleven respondents who identified the urban forest in their neighborhood as poor voted for the proposal, which was statistically significant at the p=.10 level.

Respondents' urban forest knowledge was also examined. Those who were somewhat knowledgeable about urban forests were more likely to vote for the hypothetical ballot proposal, while those who were not at all knowledgeable were less likely to vote for the proposal. Both of these cross-tabulation were statistically significant at the p=.05 level. This helps to validate the contingent valuation portion of the study, as those with greater knowledge about a non-market environmental resource should be more likely to be willing to pay for it (Mitchell and Carson, 1989).

Table 18: Attitudinal Voting Patterns

Attitudinal Category	N in Category	% For Proposal	P-Value
Neighborhood			
More Trees	40	80	.004
Less Trees	10	20	.003
Current Amount	53	58.5	.382
Visit			
Daily	44	68.2	.320
Weekly	31	67.7	.484
Monthly	11	63.6	.941
Yearly	11	45.5	.214
Never	4	50	.595
Dk/Na	6	33.3	.127
Neighborhood Rating			
Excellent	17	64.7	.846
Good	49	67.3	.353
Fair	26	69.2	.423
Poor	11	36.4	.057
Dk/NA	4	25	.113
City Rating			
Excellent	4	100	.115
Good	43	53.5	.110
Fair	45	71.1	.122
Poor	6	83.3	.280
Dk/NA	9	33.3	.058
Knowledge			
Very	5	60	.901
Somewhat	41	75.6	.029
Very Slightly	34	61.8	.901
Not At All	22	40.9	.018
Dk/NA		37.5	.127

The conservative Turnbull distribution-free estimator (Haab and McConnell, 2002) was used to estimate willingness to pay. The first use of this technique in contingent valuation was by Carson et al. in 1994 (cited in Haab and McConnell, 2002), and Vesely's (2007) study discussed in the literature review used the method (along with

other parametric techniques) to estimate WTP for urban forests in New Zealand This is a non-parametric technique that makes no assumptions about the distribution of WTP, reducing potential for bias due to misspecification. These estimates were made even more conservative by treating don't know/no answer responses to the valuation question as no responses. The only information available to the researcher in this model is that if a respondent answers yes to a particular bid level, their WTP is greater than or equal to that amount, and that it is less than that amount if they answer no. As the sample and bid prices were assigned randomly, each individual response to the hypothetical ballot proposal can be understood as the outcome of an individual Bernoulli trial (or weighted coin flip). This interpretation leads to the construction of maximum likelihood estimators for the probability of respondents voting for the proposal at each bid level. This leads to the equation:

$$F_j = N_j/T_j$$

Where F_j is the probability that WTP is less than the offered price t_j, N_j is the number of respondents answering no to the offered price t_j, and T_j is the total number of respondents offered price t_j (Haab and McConnell, 2002). This means that our best estimate of the probability of a no response to a given price without imposing any assumptions on the model is the sample proportion of no responses to that price.

When more than one price is offered to respondents, monotonic restrictions are imposed upon the sample results if they are not already present. This means that the percentage responding no to each offered price should increase as the price increases

($F_j \leq F_{j+1}$). While monotonicity should theoretically exist already, random sampling techniques, bid designs, and sample sizes often result in responses that are not monotonic (Haab and McConnell, 2002).

Analyzing the monotonicity of results requires the estimation of all F_j simultaneously. Estimations are compared and results for bid levels that are not monotonic are pooled back to the previous bid level to enforce monotonicity. The F_j resulting from this study are illustrated in Table 19.

Table 19: Turnbull Estimates

Bid Level (t_j)	Number Offered (T_j)	Number of No's (N_j)	F_j (= N_j / T_j)
5	30	15	.50
7	36	14	.389
9	41	11	.268
5*	107	40	.374

As discussed previously, the results from this survey are not monotonic. F_j decreases rather than increases as bid price increases. Monotonicity is enforced by pooling all responses back to the t_j of \$5. This results in T_j equaling 107, N_j equaling 40, and F_j equaling .374, also shown in table 19 in the row labeled 5*.

This restriction to monotonicity results in a single price case. Estimating a conservative lower bound for WTP in this single price case can be accomplished by multiplying the offered price by the probability of willingness to pay being above the offered price (Haab and McConnell, 2002). This is illustrated by the equation:

$$E_{LB}(WTP) = t(1-F_t)$$

Where t= the single price and LB= lower bound. In this study, the offered price was $5 and the probability of a yes response was .626, so expected willingness to pay must be at least $3.23. The variance is given by (Haab and McConnell, 2002):

$$V\left(E_{LB}(WTP)\right) = \frac{F_j\ (1 - F_j)}{T_j}\ (t_j\ \ - t_{j-1})^2$$

Given our results, this becomes:

$$V\left(E_{LB}(WTP)\right) = \frac{0.374 \times .626}{107}\ (5 - 0)^2$$

Yielding $V\left(E_{LB}(WTP)\right)$ = 0.0547. The standard deviation (s) is the square root of this variance, or 0.2339. This allows us to calculate the standard error of the estimate (Field, 2005):

$$\sigma = \frac{s}{\sqrt{n}} = \frac{0.2339}{\sqrt{107}} = .023$$

The standard error allows us to construct a 95 percent confidence interval for the lower bound of WTP:

$$3.23 \pm 1.96 * .023\ = (3.18, 3.28)$$

This allows us to say with 95 percent confidence that the lower bound of WTP resides between $3.18 and $3.28. We can be 95 percent confident that the sample would be willing to pay between $3.18 and $3.28 to see their urban forest resource in the City of Tampa increase by 250,000 trees. Aggregating this confidence interval to the sample of 107 respondents yields a point estimate of $345.61 and a 95 percent confidence interval for the lower bound total sample WTP of ($340.26, 350.96). Aggregating to the population of Tampa residents over the age of 18 (262,644) yields a point estimate of $848,340.12 and a 95 percent confidence interval for the lower bound of total WTP of ($835,207.92, $861,472.32). This aggregation is not completely reliable, as the sample did not exactly match the demographics of the City of Tampa.

In summary, when compared to residents of the City of Tampa aged over 18, the sample contained more females, less minorities, less of those in the lowest income and education categories, and more of those in the higher income and education categories. While gender and race/ethnicity did not have a statistically significant effect upon voting decisions in the hypothetical ballot proposal, income and education did. Those with higher incomes and educations were more likely to vote for the proposal, with the converse being true for those with lower incomes and educations. As the sample contained a greater proportion of those with higher education and incomes and these groups were more likely to be willing to pay to improve their urban forest resource, aggregations from the sample to the population must be treated with suspicion. The conservative bid design and estimation techniques can help to ease these suspicions.

Various Parametric estimation methods were also completed. These included linear and log-linear logit and probit regression models using the Random Utility Model

(Haab and McConnell, 2002). Unfortunately results from these models were not significant, despite a great deal of manipulation, limiting the estimates upon covariates of WTP to cross-tabulations and chi-square analysis.

Manipulation Checks

Directly following the valuation scenario and question were two manipulation checks, both of which followed the recommendations of the NOAA Guidelines (NOAA, 1993). The first manipulation check asks respondents to identify why they voted for or against the hypothetical ballot measure presented to them in the valuation scenario. This allows the determination of whether respondents were voting according to prevailing economic theory, i.e., whether the respondents were valuing the resource in question based upon the utility received from it rather than rejecting the hypothetical market scenario or the payment vehicle, otherwise known as protest bids (Carson et al., 1996; Krupnick and Adamowicz, 2007). Respondents were asked for the reasons that they voted for or against the hypothetical ballot measure in the question directly after it. Options included: environmental benefits of trees, community benefits of trees, trust in government, clarity of proposal, too many taxes, already enough trees, more important uses for tax money, and a don't know/no answer option. Too many taxes and trust in government as answers to this manipulation check could indicate protest bids, although a positive trust in government could be associated with voting for the proposal. Clarity of proposal could also be associated with both a for and against vote, as clarity could be a reason for voting for the proposal and lack of clarity could be a reason for voting against

it. Respondents were instructed to mark all answers that applied, so the numbers do not add up to 107 and the percentages do not add up to 100.

Results from this question and cross-tabulations with voting behavior are presented in Table 20. Environmental and community benefits of the proposal (reasons for voting for the proposal) were the two highest rated voting reasons, at 56.1 and 43 percent, respectively. Respondents who identified these two voting reasons voted for the proposal at levels of 98.3 and 100 percent, respectively. Clarity of the proposal and trust in government, the two ambiguous voting reasons that could lead to being for or against the proposal were identified as voting reasons by 19.6 and 12.1 percent of respondents, respectively. Clarity of proposal showed an almost even split in voting patterns, as 57.1 percent of respondents who identified this as a voting reason voted for the proposal. Clarity of the proposal was the only voting reason that did not show high statistical significance, as the rest of the voting reasons were significant at the p=.01 level, using chi-square tests to evaluate the significance of the cross-tabulations. Trust in government was a negative factor in voting patterns, as only 7.7 percent of respondents who identified this as a voting reason voted for the proposal. The two economically rational reasons for voting against the proposal, already enough trees and more important uses for tax dollars were identified as voting reasons by 5.6 and 15 percent of respondents, respectively. No respondents who identified already enough trees as a voting reason voted for the proposal, while only 6.3 percent of respondents who identified more important uses for tax money voted for the proposal. Too many taxes, the one clear indication of a protest vote, was identified by 15.9 percent of responds as a reason for why they voted in the manner that they did. No respondents who identified too many taxes as a voting reason

voted for the proposal. The don't know/no answer option was chosen by 9.3 percent of respondents.

Table 20: Respondents' Voting Reasons

Voting Reason	N	% Of Resp.	% For	P-Value
Environmental Benefits	60	56.1	98.3	.000
Too Many Taxes	17	15.9	0	.000
Already Enough Trees	6	5.6	0	.001
More Important Uses For Tax $	16	15	6.3	.000
Community Benefits	46	43	100	.000
Clarity of Proposal	21	19.6	57.1	.563
Trust in Government	13	12.1	7.7	.000
Don't Know/No Answer	10	9.3		.025

The second manipulation check asked respondents to identify their level of understanding of the hypothetical proposal which they had just voted on. This is important to identify, as a contingent valuation scenario that was not understood by a majority of its respondents would have extremely questionable validity (NOAA, 1993). A five point Likert scale with a don't know/no answer option was used for this question. Results are presented in Table 21. Results negated this concern about survey validity, as 46.7 percent of respondents understood the survey completely and 31.8 percent mostly understood. The survey was slightly understood by 14 percent of respondents and not understood at all by only one respondent. The don't know/no answer option was chosen by 6.5 percent of respondents. Cross-tabulations with the different levels of understanding and voting decisions were analyzed to determine if understanding had an effect upon voting decisions. The only statistically significant level of understanding was

the don't know/no answer response, where respondents who chose this answer were less likely to vote for the proposal.

Table 21: Respondent Level of Understanding

Level of Understanding	N	% of Respondents	% Yes	P-Value
Completely	50	46.7	70.6	0.498
Mostly	34	31.8	66.0	0.245
Slightly	15	14	53.3	0.423
Not At All	1	0.9	0	0.193
Don't Know/No Answer	7	6.5	28.6	0.054

Another type of manipulation check that is often overlooked in contingent valuation studies is survey neutrality (Boyle, 2003). Whether intended or not, question wording, structure and order can provide value cues to respondents that can influence responses. It is important to construct a survey that is value neutral and avoids these subtle cues. While all effort was done to remain neutral in the construction and execution of this survey, it was still necessary to ask respondents if they felt that the survey had tried to influence them in any way. This was presented in the very last item on the questionnaire, using a six point Likert scale that included a don't know/no answer option. Results are shown in Table 22. Almost sixty percent of respondents replied that the survey was neutral (59.8 percent). 8.4 percent felt that the questionnaire tried to get them to vote for the proposal, while 16.8 percent felt that it slightly tried to get them to vote for the proposal. No respondents felt that the questionnaire tried to influence them to vote against the proposal. The don't know/no answer option was chosen by 11.2 percent of respondents. The results of this question to help to ensure survey neutrality and influence.

Interestingly, of the 27 respondents who felt that the survey tried to influence them towards voting for the hypothetical ballot proposal, the majority (14) voted for the proposal anyway. Seven of these respondents voted against the proposal, and six chose the don't know/no answer option.

Table 22: Survey Neutrality

Influence Level	N	%
Tried For	9	8.4
Slightly Tried For	18	16.8
Neutral	64	59.8
Slightly Tried Against	0	0
Tried Against	0	0
Don't Know/No Answer	12	11.2

Additional Comments

Respondents were instructed to provide any additional comments they might have on a large space provided on the back of the questionnaire. Comments were provided by 26 respondents, or 24.3 percent of total respondents. Many of the comments were not easily classifiable, speaking to specific issues respondents had in the past with trees on their property, or certain types of trees that they would like to be planted (natives, flowering trees, etc). Six of the comments expressed displeasure with current City maintenance of trees, something that should be taken into account by tree agencies locally. Two comments acknowledged the importance and benefits of trees, but cited tough economic times as reasons for voting against the hypothetical ballot proposal. This was a major concern conducting this study in a time of economic downturn. One comment was vehemently anti-tax, another concern going into this study based upon the

chosen payment vehicle. Four other comments were acknowledged the benefits of trees and wished for more.

CHAPTER FIVE:

CONCLUSIONS

This research was conducted to examine unmeasured values attributed by residents of the City of Tampa to their urban forest resource. Urban areas are becoming increasingly popular subjects of study within geography and other disciplines as the majority of humanity now resides within urban areas. Urban forests provide environmental, social, and economic benefits to urban residents that are often overlooked due to the pressures of physical and economic expansion. Estimating urban forest benefits can help them compete with other concerns when allocating among competitive land and fiscal demands.

Five possible methodologies for estimating urban forest benefits in the City of Tampa were examined for potential application. These methods included the traditional environmental economics techniques of travel cost, hedonic price methods, and contingent valuation. Novel approaches in estimating the value of rainwater interception and increased consumer preferences in forested urban areas were also investigated briefly. Although each of the estimation methods had its own strengths and weaknesses, contingent valuation was chosen as the most appropriate tool to estimate the value attributed to Tampa's urban forest by City residents.

Once contingent valuation was chosen, a detailed methodology for its application was constructed through utilization of three decades of contingent valuation and survey research preceding this study. Emphasis was placed upon following as closely as possible given temporal and fiscal constraints the recommendations of the Nobel Laureate headed blue-ribbon NOAA Panel (NOAA, 1993) that positively evaluated contingent valuation. Dillman's (2007) tailored design mail survey methodology was followed as closely as possible to achieve the highest possible response rate.

The survey's execution resulted in one hundred and seven complete responses out of five hundred sample units, or a response rate of 21.4 percent. While this is less than ideal and a higher response rate would have been desirable, many studies in other fields achieve similar rates (Paez and Whalen, 2010) and the American Association for Public Opinion Research has recently warned against the perils of rejecting studies simply due to their low response rates (American Association for Public Research, 2010). Recently published contingent valuation studies of urban forests have had similar response rates (Lorenzo et al., 2000). A relaxation of temporal and financial constraints imposed upon this research could have improved response rates.

Respondent demographics were compared with City of Tampa demographics of those aged over 18 to determine the representativeness of the sample. Z-tests for proportion were used to determine statistical significance. When compared to residents of the City of Tampa aged over 18, the sample contained more females, less minorities, less of those in the lowest income and education categories, and more of those in the higher income and education categories.

Attitudinal and behavioral responses provided information on how respondents perceived their urban forest resource in Tampa. Aesthetics and shade were the urban forest benefits identified by the most respondents, while recreation and public safety were the two benefits identified by the lowest number of respondents. While a small percentage of respondents chose the don't know/no answer option for these attitudinal questions, no respondents replied that Tampa's urban forest provided no benefits. Root damage, pollen/allergies, and sidewalk damage were the three problems associated with Tampa's urban forest identified by the greatest number of respondents. The two problems rated lowest by respondents were increased insurance and fire. Twelve percent of respondents replied that there were no environmental or community problems associated with Tampa's urban forest. These attitudinal results are similar to those garnered from other studies from both the United States and internationally.

The source of respondents' urban forest information was another useful attitudinal result of this study. Television, the internet, and friends and family were the three information sources identified by the highest percentage of respondents. Books, home improvement stores, and neighborhood or homeowner associations were the next three highest rated information sources identified by respondents. City or County government and extension services were the two lowest rated sources of information, at 19.6 and 9.3 percent, respectively. These low ratings could serve to motivate these agencies to increase their advertising, or tailor it to the informational mediums favored by respondents.

Attitudinal questions also asked respondents to rate Tampa's urban forest, both in their neighborhood and city-wide. Respondents were given a four point Likert scale that

included a don't know/no answer option. Regarding the quality of trees in Tampa, responses clustered in the middle of the scale, with 40.2 percent of respondents choosing the good option and 42.1 percent choosing the fair option. Only 3.7 percent rated City trees as excellent, and only 5.6 percent rated City trees as poor. Nine respondents, or 8.4 percent chose the don't know/no answer option for this question. Trees in respondents' neighborhoods were more highly rated, with 15.7 percent answering excellent and 45.3 good. The fair option was taken by 24.3 percent of respondents, and 3.7 percent of respondents chose the don't know/no answer option. It is notable that 10.3 percent of respondents replied that trees in their neighborhood were poor, more than twice the proportion of those who replied in this manner when rating trees citywide.

The valuation question was phrased as "**If there was a ballot proposal for a one-time tax of x$ to increase Tampa's urban forest citywide, on all types of land uses by 250,000 trees of all types, would you vote <u>for</u> or <u>against</u>, remembering your household's expenses and budget constraints?**".

This question was designed to address the first research question proposed in this study:

Research Question One: Do the residents of the City of Tampa value an increase in the City's urban forest resource?

Hypothesis: An increase in the provision of the City of Tampa's urban forest resource would be valued by residents.

Of 107 respondents, 67, or 62 percent voted for the hypothetical ballot proposal at bid levels of 5, 7, and 9 dollars. Only 17 respondents, or 15.9 percent voted against the proposal, while 23 respondents, or 21.5 percent chose the don't know/no answer option. At each of the three bid levels, a majority of respondents voted for the hypothetical ballot proposal. This shows that respondents were willing to pay to increase their urban forest resource in Tampa. There is not enough evidence from the survey responses to disprove the first research hypothesis.

The Turnbull distribution-free estimator was used to estimate a lower bound for willingness to pay. This non-parametric estimator makes no assumptions about the distribution of WTP. The conversion of don't know/no answer responses to the valuation question to no responses further served to make estimates of WTP conservative. A 95 percent confidence interval for the lower bound of WTP was constructed using this technique. The results showed that respondents were willing to pay between $3.18 and $3.28 to increase their urban forest resource in Tampa by 250,000 trees. Aggregating to the population of Tampa residents over the age of 18 (262,644) yields a 95 percent confidence interval for total WTP of ($835,207.92, $861,472.32). This aggregation is not completely reliable, as the sample did not exactly match the demographics of the City of Tampa. In summary, when compared to residents of the City of Tampa aged over 18, the sample contained more females, fewer minorities, fewer of those in the lowest income and education categories, and more of those in the higher income and education categories. While gender and race/ethnicity did not have a statistically significant effect upon voting decisions in the hypothetical ballot proposal, income and education did. Those with higher incomes and educations were more likely to vote for the proposal, with

the converse being true for those with lower incomes and educations. As the sample contained a greater proportion of those with higher education and incomes and these groups were more likely to be willing to pay to improve their urban forest resource, aggregations from the sample to the population must be treated with suspicion. The conservative bid design and estimation techniques can help to ease these suspicions.

Cross-tabulations with the vote in the hypothetical ballot proposal revealed which demographic and attitudinal variables influenced respondents' votes, addressing the second research question:

Research Question Two: Will the levels of willingness to pay expressed by respondents correspond with prevailing economic and preference theory?

Hypothesis: Willingness to pay estimates garnered from this study will conform to the prevailing economic and preference theories. WTP will correlate positively with income, education, environmental preferences, and use and knowledge of Tampa's urban forest resource.

Respondents aged 36-49 were more likely to vote for the proposal than other age groups. Those in the highest income bracket (greater than $100,000 per year) were more likely to vote for the proposal, as were those with graduate or professional degrees. Respondents who had completed some high school or obtained high school diplomas or equivalencies were less likely to vote for the proposal. Gender, race/ethnicity, or the type of area where respondents grew up were not statistically significant factors affecting votes in the hypothetical ballot proposal. These cross-tabulations served to validate the contingent valuation scenario, as prevailing economic theory states that likelihood to be

willing to pay for environmental improvements should increase with income and education.

The attitudinal voting patterns generally serve to validate the results of the survey, as they proceed in a logical pattern consistent with economic theory. Of those who wanted more trees in their neighborhood, eighty percent voted for the proposal, while only 20 percent of those who wanted fewer trees did. These two cross-tabulations were significant at the p=.01 level. Likelihood to vote for the proposal increased with frequency of visitation of areas with trees, the proxy for use in this study, although these likelihoods were not statistically significant. This helps to validate the contingent valuation portion of this study, as those who use an environmental resource should be more willing to pay for it than those who do not (Mitchell and Carson, 1989; Whitehead, 2006). For the most part, as respondent rating of urban forest resources in their neighborhood and the city as a whole decreased, respondent likelihood to vote for the proposal increased. Respondents' knowledge of urban forests was also cross-tabulated with voting decisions. Those who were somewhat knowledgeable about urban forests were more likely to vote for the proposal, and those who were not at all knowledgeable were less likely to vote for the proposal. This also helps to validate the contingent valuation portion of the study, as those who are more knowledgeable about a non-market environmental resource should be willing to pay more for it (Mitchell and Carson, 1989).

The analysis of cross-tabulations of demographic and attitudinal variables with respondent voting decisions did not reveal enough evidence to disprove the second research hypothesis. There was a statistically significant increase in the proportion voting for the proposal in the highest income bracket, while the lowest education level was less

likely to vote for the proposal and the two highest were more likely. While not statistically significant, the proxy for use of the urban forest research increased in tandem with the proportion likely to vote for the proposal. The same was true for members of environmental groups. Increased knowledge of the urban forest resource led to an increased likelihood to vote for the proposal.

Three important manipulation checks followed the valuation question. These attempted to ascertain: the reasons respondents voted the way they did for the proposal, respondents' understanding of the proposal, and whether the respondents felt that the survey as a whole attempted to influence them in any way for the proposal. Each of the three manipulation checks served to help validate the hypothetical ballot proposal results of the contingent valuation scenario.

The cross-tabulation of respondents' reasons for voting the way that they did on the proposal with their actual vote allows the determination of whether they were voting according to prevailing economic theory. Those who identified voting reasons that correspond with voting for the proposal should have voted for the proposal, and vice versa. This was found to be true, as 98.3 percent and 100 percent of those who identified environmental benefits and community benefits as voting reasons voted for the proposal, respectively. Conversely, zero percent and 6.3 percent of those respondents who identified already enough trees and more important uses for tax money as voting reasons voted for the proposal, respectively. All of these cross-tabulations were statistically significant at the $p=.01$ level. Clarity of the proposal was an ambiguous voting reason, as 57.1 percent of respondents who identified this as a voting reason voted for the proposal, failing to give the cross-tabulation statistical significance.

Respondent understanding is an important condition necessary for the validity of any contingent valuation study (NOAA, 1993). A five point Likert scale with a don't know/no answer option was used for this question. Results negated this concern about survey validity, as 46.7 percent of respondents understood the survey completely and 31.8 percent mostly understood. The survey was slightly understood by 14 percent of respondents and not understood at all by only one respondent. The don't know/no answer option was chosen by 6.5 percent of respondents.

The final manipulation check involved survey neutrality, an important concern for any survey, including contingent valuation. While all effort was done to remain neutral in the construction and execution of this survey, it was still necessary to ask respondents if they felt that the survey had tried to influence them in any way. This was presented in the very last item on the questionnaire, using a six point Likert scale that included a don't know/no answer option. Almost sixty percent of respondents replied that the survey was neutral (59.8 percent). 8.4 percent felt that the questionnaire tried to get them to vote for the proposal, while 16.8 percent felt that it slightly tried to get them to vote for the proposal. No respondents felt that the questionnaire tried to influence them to vote against the proposal. The don't know/no answer option was chosen by 11.2 percent of respondents. The results of this question to help to dispel concerns surrounding survey neutrality and influence.

Interestingly, of the 27 respondents who felt that the survey tried to influence them towards voting for the hypothetical ballot proposal, the majority (14) voted for the proposal anyway. Seven of these respondents voted against the proposal, and six chose the don't know/no answer option.

This study answered the proposed research questions and supported the research hypotheses. Information garnered from this research could be used by key decisionmakers in the City of Tampa to improve the provision of the City's urban forest and to increase educational efforts so that it is better understood and appreciated by residents. That being said, there are several possible areas for improvement and next steps for future research.

The first and most obvious of these improvements involves the representativeness of the sample and response rate. Both of these key factors were restrained by temporal and financial concerns. Dillman's (2007) Tailored Design Method calls for four points of contact, while only two were made in this study. Additional funding and time available to complete research could allow for further points of contact that could serve to increase response rate and draw responses from demographic groups that are under-represented in the current group of respondents.

Conducting further contingent valuation studies in the future could help to explain how urban forest preferences and values change over time in the City of Tampa. Such longitudinal examination could help to explain drivers of landscape change in the City and prove an aid to the emerging field of political ecology. Further contingent valuation studies could be conducted elsewhere in Florida or throughout the United States to explore how local and regional cultural and social variations influence perceptions and values of urban forest resources.

Future contingent valuation studies could also benefit from methodological improvements. One of these possible improvements would be the inclusion of maps or photographs to better illustrate the current and possible future distribution of Tampa's

urban forest based upon the results of a hypothetical ballot proposal. Such an increase of respondent understanding of the components and results of what they were voting on would result in more realistic preference formation.

While the validity of stated preference studies such as contingent valuation was discussed in great detail to alleviate concerns expressed by many regarding the reliability of economic preferences gained from survey work, there are still those who regard such preferences with veiled suspicion. Such concern could be answered by conducting revealed preference studies to estimate values for Tampa's urban forest. A hedonic evaluation of the affect that Tampa's urban forest has upon real estate prices in the City could further establish the benefits generated by this resource and help to increase its distribution.

Another environmental economics technique that could be employed in further research is contingent ranking. In contingent ranking, respondents are given a set of hypothetical situations, differing in levels of environmental amenities and other characteristics, and asked to rank them. If these characteristics are expressed in monetary values, it allows for benefit estimation. The advantage of this technique over contingent valuation is valuing different levels of an amenity, or different amenities in a set of scenarios, which can better simulate the type of trade-offs likely to be present in a real life situation where money is being appropriated to pay for public goods. The downside of this method is the added cognitive burden placed upon respondents with each new element added to the hypothetical valuation scenarios.

Lastly, while preferences are examined and discussed in this research, there remains a great deal to learn about how Tampa residents regard their urban forest

resource. A more complete representation of urban forest perceptions and values in Tampa could be attained through conducting extensive in-person qualitative interviews. This type of in-depth analysis could allow for a deeper exploration of cultural and social differences between groups' perceptions and valuations of urban forests. Understanding these cultural differences could help to further align urban forest marketing and maintenance activities with the wants and needs of Tampa residents. The results from such a process could prove very useful in providing a distribution of the urban forest resource that was aligned with resident needs and wants.

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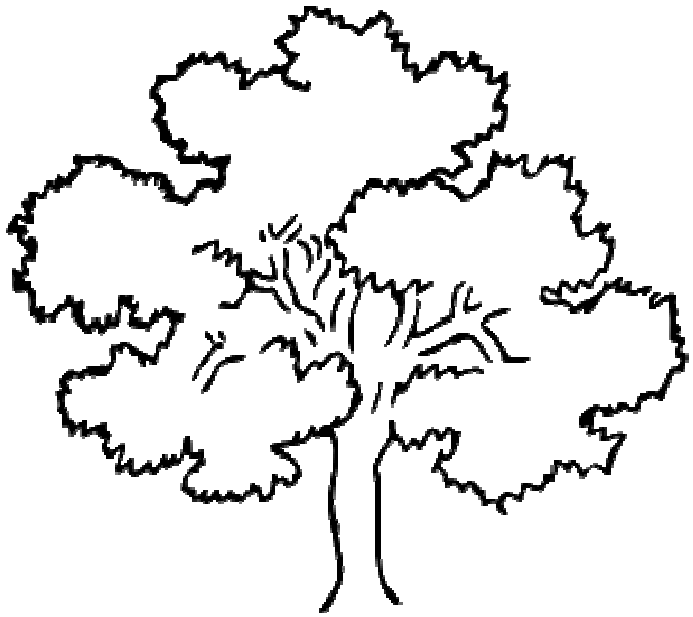
APPENDICES

Appendix One: Survey and Mailing Materials

What Do YOU Think About Tampa's Urban Forest?



USF UNIVERSITY OF SOUTH FLORIDA

What Do YOU Think About Tampa's Urban Forest?

This survey is separated into three parts. The first part asks questions about your beliefs, attitudes, and experiences related to urban forests, the second part asks you about an urban forest ballot proposal, and the final section asks about your characteristics. Remember that the urban forest includes any type of tree in Tampa, whether it is in a park, a street, someone's yard, or elsewhere.

1. **In your neighborhood would you like there to be: (please mark one)**

- ☐ More Trees
- ☐ Less Trees
- ☐ The current amount of trees is just right
- ☐ No opinion/don't know

2. **What do you feel are the community benefits of Tampa's urban forest? (please mark all that apply)**

- ☐ Aesthetics/beauty
- ☐ Recreation
- ☐ Property values
- ☐ Shade
- ☐ Sound reduction
- ☐ Public safety
- ☐ Privacy
- ☐ No Benefits
- ☐ Don't know/no answer

☐ Other:_____
_____

3. **What do you feel are the environmental benefits of Tampa's urban forest? (please mark all that apply)**

☐ Stormwater management

☐ Reduces air pollution

☐ Reduces global warming

☐ Energy conservation

☐ Wildlife Habitat

☐ No Benefits

☐ Don't know/no answer

☐ Other:_____
_____

4. **What do you feel are the community problems associated with Tampa's urban forest? (please mark all that apply)**

☐ Blocks signage

☐ Cost of tree care

☐ Cost of leaf removal

☐ Increased insurance

☐ Sidewalk damage from roots

☐ Unsightliness of poorly managed trees

☐ No problems

☐ Don't know/no answer

☐ Other:_____
_____

5. **What do you feel are the environmental problems associated with Tampa's urban forest? (please mark all that apply)**

☐ Root damage to paved areas or foundations

☐ Pollen/allergies

☐ Downed limbs

☐ Hurricane damage

☐ Fire

☐ No problems

☐ Don't know/no answer

☐ Other:_____
____

6. **How knowledgeable are you about Tampa's urban forest? (please mark one)**

☐ Very knowledgeable

☐ Somewhat knowledgeable

☐ Very slightly knowledgeable

☐ Not knowledgeable at all

☐ Don't know/no answer

7. **Where do you get your information about urban forests and trees? (please mark all that apply)**

- ☐ Television
- ☐ Internet
- ☐ Books
- ☐ Extension Service
- ☐ Friends and family
- ☐ City/County government
- ☐ Home Improvement stores (Lowes, Home Depot, etc.)
- ☐ Neighborhood or homeowner association
- ☐ Don't get any information about urban forests and trees
- ☐ Don't know/no answer
- ☐ Other:_____

8. **How often do you visit areas with trees other than your own property? (please mark one)**

- ☐ Daily
- ☐ Weekly
- ☐ Monthly
- ☐ Yearly
- ☐ Never

☐ Don't know/no answer

9. **How would you rate the quality of Tampa's urban forest in your neighborhood? (please mark one)**

☐ Excellent

☐ Good

☐ Fair

☐ Poor

☐ Don't know/no answer

10. **How would you rate the quality of Tampa's urban forest citywide? (please mark one)**

☐ Excellent

☐ Good

☐ Fair

☐ Poor

☐ Don't know/no answer

11. **Do you feel that more of your tax money should be used to address any of these issues? (please mark all that apply)**

☐ Environmental problems

☐ Education

☐ Community assistance programs

☐ Healthcare

☐ Police

☐ Prisons

☐ No more tax money should be used for these issues

☐ Don't know/no answer

Valuation Section

This section asks you questions about your willingness to pay for urban forests to get a better picture of how people value them and why. Remember that Tampa's urban forest is any tree of any type on any land use inside of city limits. Currently there are approximately 7.8 million trees in Tampa's urban forest.

12. **If there was a ballot proposal for a one-time tax of x$ to increase Tampa's urban forest citywide, on all types of land uses by 250,000 trees of all types, would you vote for or against, remembering your household's expenses and budget constraints? (please mark one)**

☐ For the proposal

☐ Against the proposal

☐ Don't know

13. **Please explain the reason you voted for or against the ballot proposal? (please mark all that apply)**

☐ Environmental benefits of trees

☐ Too many taxes

☐ Already enough trees

☐ More important uses for tax money

☐ Community benefits of trees

☐ Clearness of proposal

☐ Trust in government

☐ Don't know/no answer

☐ Other:_____
_____

14. **How well do you feel that you understood the ballot proposal you just voted on? (please mark one)**

☐ Completely understood

☐ Mostly understood

☐ Slightly understood

☐ Didn't understand at all

☐ Don't know/no answer

Demographic Section

This final section of the questionnaire asks questions about your demographic characteristics so that we can see if people in different groups hold different values for urban forests. The answers will be used only for group comparisons and will not be connected to you in any way.

15. **Was the area that you grew up in? (please mark one)**

☐ Urban

☐ Suburban

☐ Small town

☐ Rural

☐ Don't know/no answer

16. **What is your age? (please mark one)**

☐ 18-21

☐ 22-35

☐ 36-49

☐ 50-64

☐ 65+

17. **Are You? (please mark one)**

☐ Male

☐ Female

18. **What is your ethnicity? (please mark one)**

☐ Caucasian

☐ African-American

☐ Latin

☐ Asian

☐ Other

19. **What is your level of education? (please mark one)**

☐ Some high school

☐ High school diploma/GED

☐ Some College

☐ Bachelor's degree

☐ Graduate/professional degree

20. **Are you a member of an environmental group? (please mark one)**

☐ Yes

☐ No

21. **What is your approximate yearly income? (please mark one)**

☐ Less than $20,000

☐ Between $20,000 and $40,000

☐ Between $40,000 and $60,000

☐ Between $60,000 and $100,000

☐ More than $100,000

22. **Do you feel that this survey attempted to influence you in any direction? (please mark one)**

☐ Tried to get me to vote for the urban forest improvements

☐ Slightly tried to get me to vote for the urban forest improvements

☐ Let me make up my own mind about this issue

☐ Slightly tried to get me to vote against the urban forest improvements

☐ Tried to get me to vote against the urban forest improvements

☐ Don’t know/no answer

Please Write Any Additional Comments You May Have Below:

Thank You Very Much For Completing this Important Survey!
Please Return it to us in the Enclosed Stamped, Addressed Envelope.
If You Need a New Envelope, Please Call Dr. Graham Tobin at:

Appendix 2: First Cover Letter:

February 17 2010(mail-out date)
Inside Address

I am writing to you to request your help in an important new University of South Florida study being done to determine the values and perceptions that Tampa residents assign to their urban forest. Tampa's urban forest consists of any tree of any type within the city limits, whether it is in a park, along the side of the road, in someone's backyard, or elsewhere.

Results from this survey will be used to help make Tampa a better place to live. Knowing the way that residents feel about trees will allow for the City to do a better job with trees. I also hope to publish the useful results from this study in academic journals.

You were chosen in a random sample of Tampa residents over the age of eighteen, if you are less than eighteen years old; please return the unanswered questionnaire in the enclosed stamped envelope.
Your answers are completely confidential and your name will never be released in any report. Participation in this study is completely voluntary and should take around fifteen minutes. There are no right or wrong answers, please base your responses on your feelings and experiences. If you do choose not to respond, please let us know by returning the questionnaire in the enclosed stamped envelope.

If you have any questions or comments about this study, or would like to receive a summary of results, please feel free to contact me or study coordinator Dr. Graham Tobin at the address on this letterhead.

Thank you very much for helping us with this important study,
Sincerely,
Alec L Foster
Alec L Foster
PS: Thank you again for helping us to improve the City of Tampa!

Appendix 3: Reminder Postcard:

Date,

Last week a questionnaire about urban forest perceptions and values in Tampa was mailed to you. You were chosen randomly from a list of Tampa residents.

If you have already filled out and returned the questionnaire, we greatly appreciate your help in making Tampa a better place to live. If you have not, please return it as soon as possible. It is only by hearing from people like you that we can determine how Tampa residents feel about this important issue.

If you did not receive a questionnaire, need an additional copy, or have any questions, please contact us at: (813)974-2386
Sincerely,
Alec L Foster
Department of Geography
University of South Florida