ECOSYSTEM SERVICES AND CONSERVATION ALTERNATIVES: A CASE STUDY OF PUBLIC PREFERENCES AND VALUES IN NORTHEAST FLORIDA

By

BRIAN CONDON

A THESIS PRESENTED TO THE GRADUATE SCHOOL
OF THE UNIVERSITY OF FLORIDA IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF SCIENCE

UNIVERSITY OF FLORIDA

2004

This thesis is dedicated to Mom and Dad.

ACKNOWLEDGMENTS

The encouragement and practical advice of all committee members were essential to the completion of this work, and their contribution is gratefully acknowledged. Econometric analysis could not have been completed without the generous assistance of Ronald Ward; Ken Portier also aided with statistical analysis. Max Grunbaum provided helpful comments on the manuscript and Kat Carter-Finn aided in processing data. Matt Marsik assisted with handling land use data and generating figures in the manuscript and survey instrument.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF OBJECTS

Abstract of Thesis Presented to the Graduate School
of the University of Florida in Partial Fulfillment of the
Requirements for the Degree of Master of Science

ECOSYSTEM SERVICES AND CONSERVATION ALTERNATIVES: A CASE STUDY OF PUBLIC PREFERENCES AND VALUES IN NORTHEAST FLORIDA

By

Brian Condon

August 2004

Chair: John J. Haydu
Major Department: Food and Resource Economics

Residents of Northeast Florida derive many benefits from agricultural, forestry, and natural landscapes. Since many of the ecosystem good and service flows originating in the landscape are nonexclusive, few markets exist for them and their value to the public is ambiguous. Rapid population growth occurring in the region is leading to the conversion of these extensive uses to intensive uses such as residential development, which decreases the capacity of the landscape to provide many ecosystem goods and services. Service flows from the region's landscape are likely a factor influencing people's decision to migrate to the area and tourists' decision to visit the area, in addition to contributing to residents' quality of life, and as such are an important element of the local economy. Public preferences for these service flows and their nonmarket value should be a factor in decisions affecting land use in the region. This study used a choice experiment to evaluate Northeast Florida residents' preferences for different conservation alternatives featuring three types of ecosystem services: water quality and quantity

provision, wildlife habitat, and open space preservation. Three different conservation strategies were also presented to respondents: fee-simple purchases, conservation leases or agreements, and a combination of the two.

Respondents who were younger, were not landowners, or had higher incomes were more likely to choose conservation alternatives over doing nothing. Water quality and quantity provision was the preferred ecosystem service, and a combination of land purchases and conservation agreements was the preferred conservation strategy over the strategies individually. Respondents also preferred lower annual cost and greater quantities of land in alternative conservation plans. The maximum willingness to pay was for a 250,000-acre conservation alternative focused on water quality and quantity provision, half purchased and half in conservation agreements; on a household level, residents are willing to pay $43.59 annually for this alternative, totaling $18.9M for the region. Study results were applied to an evaluation of current conservation projects in the study area by using Northeast Florida residents' willingness to pay as a baseline for the values that other Floridians may hold for conservation programs in the area. While further verification of this analysis is necessary prior to making any solid assertions about the Florida Forever program, this initial result indicates that spending on Florida Forever programs in the region appears to be within a reasonable realm of what Floridians are willing to pay for such conservation activities.

CHAPTER 1
INTRODUCTION

People everywhere derive benefits from the landscape around them. Some benefits are a reflection of our physical necessity for air to breathe, food to eat, and water to drink. What is equally apparent is that other benefits transcend the essentials of survival and make important contributions to our quality of life, as the fisherman enjoying a snook's assault on a topwater plug or the amateur botanist viewing the blossom of a ghost orchid. While the essential functions of the landscape speak of the biological reality of our existence, the satisfaction people derive from the landscape is far from insignificant. Both types of benefits derived from the landscape – that is, the ecosystem that surrounds us – can be described as ecosystem goods or services. Both types of benefits factor into the social and economic development of any given region, and both are arguably becoming increasingly important in this sense.

Of course not all landscapes provide the flows of services that society enjoys and desires. Generally speaking as the intensity of land use increases, the variety and quantity of ecosystem services provided by that landscape decrease. Thus, for example, the stand of high pine on Florida's Central Ridge provides a greater flow of ecosystem services to the public than the bahia grass pasture that may replace it but which provides more than the golf course that might take its place given the appropriate socioeconomic conditions. The general decrease in public ecosystem services associated with development is mirrored by an increase in the exclusive economic benefits enjoyed by

the landowner. It follows that greater population densities and their associated increased land use intensities correlate with decreased flows of ecosystem services on a local level.

While the biological reality of our dependence on the landscape is clear, the presence of productive landscapes that provide ecosystem service flows to the public can have considerable implications for a region's economic landscape. Market activity and some demographic trends in the United States provide evidence that people and businesses are increasingly seeking to locate in areas with pleasing landscapes and abundant natural amenities. The tourism industry in many places is based on visitors pursuing enjoyment of natural amenities as well. The public's demand for amenities can thus result in important economic contributions to local and regional economies. Therefore landscapes providing an abundance of ecosystem service flows are an asset whose stewardship is of great regional interest.

People also benefit from land use change that results in intensive land uses. We all live in built housing and avail ourselves of the transportation infrastructure, among myriad other examples. The study does not argue that developed landscapes are less desirable than extensive ones, but rather seeks to identify public values associated with the conservation of extensive land uses within a regional landscape, values that are often not adequately considered in decisions because they are not expressed in the marketplace.

The broad goal of this study is to evaluate conservation alternatives and some of the ecosystem service flows arising from agricultural, forestry, and natural landscapes in a four-county region of Florida: Clay, Duval, Putnam, and St Johns counties. This area in Northeast Florida is experiencing population growth similar to the state as a whole, and the associated land use changes are altering ecosystem service flows. The evaluation

herein contributes to the public dialogue regarding the present and future trade-offs arising from land use change.

CHAPTER 2
BACKGROUND

A Framework for Considering Local Economies

Power (1996) provides a description of local economies that takes as its starting point what he refers to as the "folk view." The folk view describes a central paradigm in local economic analysis, the economic base model, which holds that local economies are based on their ability to generate income via the export of goods and services. In nonurban areas, this reflects the traditional belief that local economies are based on agriculture or the extractive industries. Export income is then circulated locally in any number of transactions, which is captured and described as an income or employment multiplier. Since not all goods are produced locally, income leaks from the local economy due to imports. The export income of the local economy is thus the foundation without which the local economy would ultimately cease to exist, and as a result local policies often make every effort to ensure its productivity.

Rather than abandon the economic base model, Power identifies its shortcomings and proposes a restructuring that allows for its correction. The economic base model discounts the character and structure of the local economy, ignoring the reality that in a one-dimensional local economy export earnings are immediately lost as leakage to imports. It also overlooks the contributions to local economies made by sources not tied to extractive industries, such as retirement income or government transfers. The model further assumes that people follow jobs, a causal relationship true to a certain extent but often contradicted in reality – people do care where they live and have preferences for

both natural and cultural elements of a given locale. Furthermore, businesses are clearly interested in the labor supply when locating an operation. The economic base model also characterizes the economy as chiefly providing individuals with material or biological necessities. This is contrary to the observation that the contribution of discretionary goods and services to the modern American economy far outweighs that of necessities. Power then argues that environmental and cultural amenities attract a higher-quality, lower-cost labor force, businesses, and retirement income, all of which generate economic activity in turn, leading to local economic diversification and development.

These additional considerations lead to Power's modification of the traditional view into a more encompassing view of the total economy. In this revision commercial activities are supplemented by contributions to well-being associated with the noncommercial sector and cultural and environmental amenities. The revision complements the emphasis on the biological necessity of the economy by identifying the discretionary goods and services that enrich our lives, and finally recognizes the importance of the qualitative characteristics of our wants and economic resources. Power's modification is useful because it is comprehensive and allows for the easy identification of the focus of the present study. It has the added advantage of simplifying the analytical context to the extent that those without formal economic training readily understand it. We will return to the model after identifying some of the "missing elements" of interest to this work, discussing the measurement of those elements, and describing the local economy in question.

Ecosystem Goods and Services

The structure and processes of the landscape, or ecosystem, that we inhabit provide goods and services that satisfy human needs either directly or indirectly. These

ecosystem goods and services are many and varied, ranging from the necessities of food and water to fuel wood to pharmaceuticals. Ecosystem processes and structures maintain air quality, provide building materials, protect human settlement from storms, and ensure the pollination of crops – all essential goods and services in modern society. Many ecosystem goods and services are nonexclusive public goods. As a result no markets exist for them, and therefore their value to society is ambiguous.

In a general sense, a range of ecosystem services fall under the umbrella of "amenities," which includes such elements as recreational opportunities and pleasing landscapes, among others. Inasmuch as amenities make a contribution to quality of life, a demand for them exists and is manifested in both market behavior and responses to valuation surveys (Johnston et al. 2001, Nord and Cromartie 1997, Ready et al. 1997, among others). These studies suggest that amenities directly and indirectly influence regional economic well-being. In any case, two things are clear: ecosystem goods and services originate in the landscape and their provision is thus intimately tied to land uses, and they represent some of the missing elements identified in Power's model of the local economy.

The flow of goods and services from landscapes is affected by land use changes. When change does occur a trade-off is made between the satisfaction of human wants and needs and the maintenance of other ecosystem structures and processes (DeFries et al. 2004). The conversion of extensive land uses to intensive ones may increase some service flows, but this is often reflected by a decrease in another service flow. For example, increases in surface water flows may occur as a result of greater runoff arising from reduced infiltration in the built landscape. This is accompanied by a decrease in

groundwater recharge however, and the net effect is likely negative. Similarly the greater biodiversity of a meticulously landscaped subdivision relative to many native habitats comes at the expense of the replacement of native species with any number of exotics (some of whom may turn out to be invasive).

While all the consequences of land use changes cannot be predicted, decision making with regard to land use should make an effort to assess the possible trade-offs involved, both present and future. This implies knowledge of ecosystem structures and processes in addition to an assessment of how the human population values the service flows from the landscape, the latter being the subject of the present work.

Economic Theory of Valuation

Having identified the portion of the economy to be examined, the economic basis for the valuation effort – the economic concept of value – needs to be defined. Here usage of the term value reflects the view that the value of an entity arises from its contribution to some other objective or purposes as described by Costanza and Folke (1997). This is instrumental value, and implies that we value objects when they are a means to an end, rather than an end in themselves. That is not to say that objects do not have a value in and of themselves. The application of such an intrinsic value is problematic to questions of environmental management and policy however, since a given element of nature cannot be assigned more or less intrinsic value than any other (Freeman 2003).

Economics is the study of how societies allocate scarce resources to achieve their objectives – in the most comprehensive sense the objective of maximizing of human well-being. The economic theory of value is based on the ability of things to satisfy human needs and wants or to increase the well-being of individuals. We can then define

environmental valuation as the measurement of the contribution of the ecosystem's functions and services to human well-being (Freeman 2003). Depending on the conceptual and geographic boundaries called for by the analysis, this can be done at a local to global scale.

Neoclassical welfare economics provides two fundamental premises for the concept of instrumental value: that the purpose of economic activity is to increase individual well-being, and that the individual is the best judge of their well-being (Freeman 1993). Individual preferences over alternative states, i.e., varying bundles of goods and services, are the basis for valuation. It is assumed that individuals act in their own self-interest, and furthermore that people can rank alternatives. The well-being derived from a given alternative is taken to be dependent on the quantities of the various goods and services present in the bundle. When evaluating economic value, anything that people want whose provision entails an opportunity cost is subject to analysis. These elements of alternative states run the gamut from food and water, to automobiles, environmental amenities, and government services.

Preferences held by individuals are characterized by nonsatiation and substitutability. In combination this implies that, from an initial state of well-being, decreases in the utility resulting from a reduced quantity of one good can be offset by utility increases from a quantitative increase in a second good such that an individual is indifferent between the two alternatives. This defines the trade-offs made by people when choosing between alternative bundles of goods and services and forms the basis of most individual choice models used to analyze and predict economic behavior both inside and outside of markets (Freeman 2003). As such it can be applied to environmental

management questions and a measurable contribution to welfare can be determined if the subject of analysis contains a monetary attribute.

While nonmarket valuation uses the same theoretical basis of individual choice as analyses of market behavior, nonmarket valuation differs from neoclassical price theory of market goods due to the public good nature of bundle elements. Flores (2003) provides a concise description of nonmarket valuation in the context of welfare economics, and the treatment presented here follows his discussion. Since an individual actor cannot alter the level of a public good, the nonmarket goods element of alternatives is fixed at a level common to all individuals, regardless of the individual's preferences for the optimal level of the public good. This alters the choice environment from one in which individuals choose bundles of market goods, represented by the vector $\mathbf{X} = [x_1, x_2, \cdots, x_n]$ for n market goods, subject to a budget constraint y, to one that includes nonmarket goods $\mathbf{Q} = [q_1, q_2, \cdots, q_n]$ at a "rationed" level. The classic utility maximization problem is thus modified to reflect the nonmarket elements:

$$\text{(2-1)} \qquad \begin{aligned} &\max U(\mathbf{X}, \mathbf{Q}) \\ &\text{subject to: } \mathbf{P} \cdot \mathbf{X} \leq y; \ \mathbf{Q} = \mathbf{Q}^0 \end{aligned}$$

where $\mathbf{P} = [p_1, p_2, \cdots, p_n]$ represents the prices of market goods and $\mathbf{Q}^0$ is the given level of nonmarket goods. The problem can be solved for the vector of optimal demands $\mathbf{X}^* = \mathbf{X}(\mathbf{P}, \mathbf{Q}, y)$, and inserted into the utility function to obtain the indirect utility function:

$$\text{(2-2)} \qquad U(\mathbf{X}^*, \mathbf{Q}) = V(\mathbf{P}, \mathbf{Q}, y).$$

Using the superscripts 0 and 1 to designate the initial and altered conditions, respectively, the dual problem of expenditure minimization can be specified as

(2-3)
$$\min \mathbf{P} \cdot \mathbf{X}$$
$$\text{subject to: } U(\mathbf{X},\mathbf{Q}) \geq U^0; \mathbf{Q} = \mathbf{Q}^0.$$

The fixing of a baseline utility level U^0 in the expenditure minimization problem allows for evaluation of compensating and equivalent welfare measures. The compensating (C) and equivalent (E) measures differ in the assignment of property rights: in the former the status quo level of a good is assumed while the latter uses the level of a good after some change as its basis. Functionally they can be represented as

(2-4a) $$V(\mathbf{P^0},\mathbf{Q^0}, y^0) = V(\mathbf{P^1},\mathbf{Q^1}, y^1 - C)$$

(2-4b) $$V(\mathbf{P^0},\mathbf{Q^0}, y^0 + E) = V(\mathbf{P^1},\mathbf{Q^1}, y^1)$$

where the superscripts 0 and 1 again represent the initial and changed conditions, respectively.

Welfare changes can also be described as originating from price or quantity changes in goods. In the case of price changes the welfare measure is thus compensating variation (CV) or equivalent variation (EV); welfare changes due to quantity changes are referred to as compensating surplus (CS) or equivalent surplus (ES). When considering an increase in the price of a good i such that $p_i^0 < p_i^1$, and representing the vector of prices without p_i as $\mathbf{P}_{-i}$,

(2-5a)
$$\begin{aligned} CV &= e(p_i^0, \mathbf{P}_{-i}^0, \mathbf{Q}^0, U^0) - e(p_i^1, \mathbf{P}_{-i}^0, \mathbf{Q}^0, U^0) \\ &= \int_{p_i^0}^{p_i^1} x_i^h(s, \mathbf{P}_{-i}^0, \mathbf{Q}^0, U^0)ds \end{aligned}$$

(2-5b)
$$\begin{aligned} EV &= e(p_i^0, \mathbf{P}_{-i}^0, \mathbf{Q}^0, U^1) - e(p_i^1, \mathbf{P}_{-i}^0, \mathbf{Q}^0, U^1) \\ &= \int_{p_i^0}^{p_i^1} x_i^h(s, \mathbf{P}_{-i}^0, \mathbf{Q}^0, U^1)ds \end{aligned}$$

where s represents p_i along the integration path and x^h is the Hicksian demand. In this case both measures would be negative. In parallel fashion, the welfare change resulting from an increase in a nonmarket good q_j, and taking $\mathbf{Q}_{-j}$ to be the vector of nonmarket goods minus j:

$$CS = e(\mathbf{P}^0, q_j^0, \mathbf{Q}_{-j}^0, U^0) - e(\mathbf{P}^0, q_j^1, \mathbf{Q}_{-j}^0, U^0) = \int_{q_j^0}^{q_j^1} p_i^V(\mathbf{P}^0, s, \mathbf{Q}_{-j}^0, U^0)ds \tag{2-6a}$$

$$ES = e(\mathbf{P}^0, q_j^0, \mathbf{Q}_{-j}^0, U^1) - e(\mathbf{P}^0, q_j^1, \mathbf{Q}_{-j}^0, U^1) = \int_{q_j^0}^{q_j^1} p_i^V(\mathbf{P}^0, s, \mathbf{Q}_{-j}^0, U^1)ds \tag{2-6b}$$

where s represents q_j along the integration path.

The phrases willingness to pay (WTP) and willingness to accept (WTA) compensation are often substituted for CV and EV, respectively. WTA thus represents the amount of compensation needed to make an individual indifferent between the status quo situation and a decrease in the level of some nonmarket good. WTP refers to the quantity of money needed to equate the original level of utility with the level associated with an increased level of a nonmarket good, and as such is the measure used in the present work.

The economic valuation concepts outlined above provide a common criterion for defining and evaluating both market and nonmarket goods while providing the structure necessary for the statistical representation of preferences. By using these economic concepts the traditional and missing elements of the total local economy are placed on an equal footing that allows for a coherent discussion of the trade-offs between elements.

CHAPTER 3
PROBLEM SETTING

Geography and Land Use

The region encompassing Clay, Duval, Putnam, and St Johns counties, herein referred to as Northeast Florida (Figure 3-1), is bounded on the east by the Atlantic Ocean and approximately bisected north to south by the St Johns River. The region as a whole contains extensive freshwater wetlands, with large expanses of salt marshes

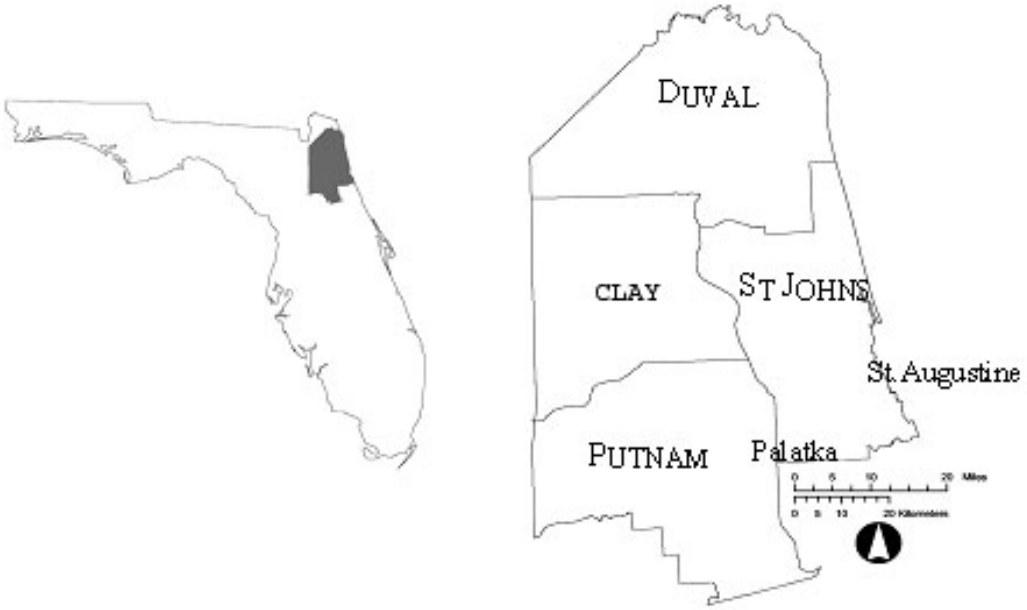

Figure 3-1: Northeast Florida study area.

associated with the Atlantic coast and St Johns River system. Upland habitats are largely flatwoods and sandhills. The most widespread agricultural use in the region is pasture, while pine plantations have been established on a large proportion of the land (Table 3-

1). Overall, extensive land uses (wetlands, forests, pine plantations, agriculture) dominate the landscape, representing approximately 75% of the region's land cover.

Table 3-1: Northeast Florida land use 2000.

	Percent of total land area				
Land Use Type	Clay	Duval	Putnam	St Johns	Region
Pasture	2.4	2.3	6.2	3.0	4.2
Other Agriculture	1.0	0.9	2.9	8.0	3.5
Extractive	3.6	0.2	0.6	0.1	1.2
Wetlands	19.6	28.7	26.9	32.6	31.8
Upland Forest	20.5	12.1	22.7	11.0	2.1
Tree Plantations	32.1	20.1	26.9	28.7	31.2
Other Upland Vegetation	3.6	3.5	2.8	3.4	3.9
Recreational	0.3	1.8	0.1	1.2	1.0
Institutional/Military/Govt.	0.8	1.2	0.1	0.2	0.7
Transportation	1.0	3.3	0.2	0.7	1.6
Commercial/Industrial	0.7	4.5	0.6	0.9	2.1
Residential	13.6	19.7	9.0	9.4	15.4
Other	1.0	1.6	0.8	0.6	1.2

Source: St Johns River Water Management District 2004.

Economic and Demographic Characteristics

Northeast Florida's total economic output in 1999 was $49.6 billion, with a total value added of $27.9B (Minnesota Implan Group 2000); total employment was 689,504. The sectors with the largest share of gross regional product included: finance, insurance, and real estate ($6.4B); services ($6.3B); government ($6.1B); and trade ($4.2B). These same sectors were also the top employers in the region, with the service industry providing 226,354 jobs at the upper end to finance, insurance, and real estate with 79,190 jobs at the lower end. In relative terms, agricultural and natural resource sectors are minor components of the economy, contributing $2.0B to the region's output and $443 million in total value added; the sector employed 17,056 in 1999.

While mean per capita income ranges widely in the four-county region, on the whole it is similar to that of Florida and the US (Table 3-2). As is the case with Florida

in general, the Northeast region is experiencing relatively rapid population growth.

Florida's 2000 population of nearly 16 million is projected to increase to over 23 million

Table 3-2: Northeast Florida annual per capita income (nominal dollars) by type, average for period 1997-2000.

County	Total personal income	Labor income	Transfer payments[a]	Other[b]	Dividends and interest
Clay	25,421	18,646	1,559	1,217	3,999
Duval	27,084	18,936	1,710	1,686	4,752
Putnam	18,665	10,250	2,713	2,169	3,533
St Johns	40,635	26,917	2,141	1,624	9,953
Florida	29,469	20,287	1,958	1,835	5,389
US	27,764	16,560	2,199	2,000	7,005

[a] Includes retirement and disability insurance benefit payments, supplemental security income payments, AFDC, general assistance payments, food stamp payments, and other assistance payments, including emergency assistance.
[b] Includes medical, veterans', federal education and training assistance, business, and other payments to individuals and payments to nonprofit institutions.
Source: University of Florida Bureau of Economic and Business Research 2002.

Table 3-3: Northeast Florida historic and projected population, 1970-2025.

	Population			% change	
County	1970	2000	2025	1970-2000	2000-2025
Clay	32,059	140,814	230,377	339	64
Duval	528,865	778,879	1,040,501	47	34
Putnam	36,424	70,423	81,743	93	17
St Johns	31,035	123,135	229,819	297	87
Region	**628,383**	**1,113,251**	**1,582,440**	**77**	**42**
Florida	6,791,418	15,982,400	23,177,652	135	45

Source: University of Florida Bureau of Economic and Business Research 2002, 2003b.

(45% growth rate) by 2025, which is similar to Northeast Florida's projected growth rate of 42% (Table 3-3). Population growth is largely the result of migration to the region, accounting for 96% of the population change in St Johns county and 63% for Duval county during the period 2000-1; statewide migrants contribute 88% of population change (University of Florida Bureau of Economic and Business Research 2002).

Population growth engenders land use changes, in particular the conversion of extensive land uses to intensive uses such as commercial, urban, and suburban development. As reported in Table 3-4, this conversion is substantial – the share of the landscape dedicated to residential development is projected to more than double between 2000 and 2010.

Table 3-4: Northeast Florida projected land use 2010.[1]

	Percent of total land area				
Land Use Type	Clay	Duval	Putnam	St Johns	Region
Agriculture	20.8	33.6	69.9	6.8	34.8
Mining	4.8	-	1.5	-	1.5
Preserve	44.5	8.4	13.9	5.0	17.2
Military	0.1	5.1	-	-	1.4
Commercial	0.9	9.1	0.5	2.3	3.4
Industrial	1.6	4.4	0.6	0.6	1.9
Residential	27.4	39.4	13.6	85.4	39.7

[1] Some land use types are not directly comparable to Table 3-1 due to divergent land use categorizations (e.g., agriculture, which includes forestry uses).
Source: Southwest Florida Regional Planning Commission 1994.

Conservation Efforts in Northeast Florida

The most important conservation program in terms of conservation land acquisition is the Florida Forever program. The Florida Forever program began implementation in 2000 and is similar to its predecessor, the Preservation 2000 program. Both programs are ambitious conservation efforts: the decade-long Preservation 2000 program raised a total of $3 billion for land acquisition and resulted in the protection of over 1.75 million acres statewide, while Florida Forever represents an additional $3 billion dollar investment over the years 2000-10 (Florida Department of Environmental Protection Division of State Lands 2004). Florida Forever is an environmental land acquisition mechanism encompassing a range of goals, including: restoration of damaged environmental systems,

water resource development and supply, increased public access, public lands management and maintenance.

Seven of the 101 projects on the 2004 priority list for Florida Forever are located in Northeast Florida (see Table 7-7 for project details). These seven projects represent a total of 350,983 acres identified for conservation efforts, 83,449 acres of which have been acquired to date. The stated goals of the Northeast Florida projects include the conservation, protection, and restoration of important ecosystems, landscapes, and forests in order to enhance or protect significant surface water, coastal, recreational, timber, fish, or wildlife resources, in addition to preservation of archaeological or historic sites (Florida Department of Environmental Protection Division of State Lands 2004). Land acquisition for the project is full fee purchase, except for the Etonia/Cross Florida Greenway that contemplates a combination of full fee purchases and conservation easements.

Focus of Present Work

Returning to Power's model of the total economy, this study seeks to provide insight into the role of elements within the economic base view of the local economy and their relationship to some unquantified missing elements of the Northeast Florida economy. The study will provide a measure of the economic value of certain ecosystem services provided by agricultural, forestry, and natural lands under conservation alternatives. By doing so it will allow for the quantification of a portion of the missing elements of the region's total economy, and will provide a fuller accounting of the importance of these land uses identified in the folk view of the local economy. While agriculture and forestry are often viewed in a favorable light as economic contributors within the economic base perspective, natural habitats generally are regarded as just the

opposite: obstacles to economic prosperity. In the context of Northeast Florida however, the role of the traditional elements of the folk economy identified in Figure 3-2 is amplified in that they are tied to the provision of the missing elements contributing to regional economic development. Although this study does not seek to identify the respective contribution of each land use individually, it does provide an argument that together they have an economic importance beyond what they contribute to the region's output.

In summary, Northeast Florida is a region characterized by both abundant natural resources and a high population growth rate. The region's growth is due largely to migration, and the natural amenities of the region likely factor into people's decision to reside there. The role of these amenities must be carefully considered when evaluating the trade-offs involved in land use decisions, and this work aims to provide illumination of some elements of these trade-offs.

CHAPTER 4
OBJECTIVE

Problem Statement

At present the full costs and benefits of natural, agricultural, urban, and suburban land uses in Northeast Florida are unclear. No market exists for many ecosystem services provided by agricultural, forestry, and natural land uses in Florida and thus their value to the public is ambiguous. This ambiguity may result in the incomplete evaluation of trade-offs regarding land use decisions that may lead to excessive conversion of extensive land uses to urban and suburban development. Degradation of ecosystem functions can be expected as a result of land conversion, as well as a corresponding decrease in the quality and quantity of ecosystem services provided to the public. This in turn will likely have wide ranging impacts on the region's economy and the quality of life of its inhabitants.

Objective

The study's objective is to appraise the value of three types of ecosystem service flows derived from agricultural, forestry, and natural landscapes in Northeast Florida in addition to public preferences for conservation strategies, fee-simple purchase and conservation leases or easements, intended to ensure the provision of nonmarket service flows from these lands.

Hypotheses

The following hypotheses were evaluated in this study:

1. The public recognizes that service flows originating from extensive land uses have value beyond that reflected in market transactions.

2. The public will express varying preferences for the different ecosystem services provided by extensive land uses.

3. The public will demonstrate varying preferences for the implementation of different conservation strategies aimed at ensuring the continued provision of ecosystem services by extensive land uses.

4. The public's demographic characteristics will influence their expressed preferences.

CHAPTER 5
LITERATURE REVIEW

Economists have devised a number of methods of valuing public goods that lack explicit markets. These methods differ in the data used in analysis, as well as their assumptions about economic actors and physical environments, and are generally grouped into indirect and direct methods (de Groot et al. 2002, Farber et al. 2002).

Revealed Preference Methods

Indirect valuation, or revealed preference, methods draw upon information on goods and services traded in the marketplace in order to describe values for associated nonmarket goods. That is, actual consumer choices are observed, and the physical and behavioral indicators result in revealed preferences for goods and services. Revealed preference methods typically provide estimates of Marshallian surplus (Freeman 1993). Common indirect valuation methods include the travel cost method, hedonic pricing, and avoided cost, among others (van Kooten and Bulte 2000); Boyle (2003) provides a concise treatment of revealed preference methods, summarized in Table 5-1.

Indirect valuation methods are subject to a number of criticisms. The models developed with indirect methods constitute a maintained hypothesis about the structure of preferences that may or may not be testable. Collinearity may also be a problem with indirect methods, precluding the isolation of factors responsible for consumers' choices. Indirect methods may also not be appropriate when the evaluation involves an

environmental change that may lie outside the realm of current experience (Mitchell and Carson 1989).

Table 5-1: Revealed preference valuation methods.

Method	Revealed behavior	Conceptual framework	Types of application
Travel cost	Participation in recreation activity and site chosen	Household consumption, weak complementarity	Recreation and other use demand
Hedonics	Property purchased; employment choice	Demand for differentiated goods	Property values and wage models
Defensive behavior	Expenditures to avoid disamenities, illness, or death	Household production, perfect substitutes	Morbidity/ mortality
Damage cost/cost of illness	Expenditures to treat illness	Treatment costs	Morbidity

Source: adapted from Boyle (2003).

Stated Preference Methods

Direct valuation, or stated preference, methods employ questionnaires or interviews to elicit consumers' willingness to pay for more or improved public goods, or alternately what they would be willing to accept as compensation for less of a public good, providing Hicksian surplus welfare measures (Freeman 1993). In either case, consumers are explicitly asked to state their preferences, but actual behavior changes are not made or observed.

Despite a number of objections leveled against them (Kahneman and Knetsch 1992), direct methods currently provide the only viable alternative for measuring nonuse values. Direct methods are also suited to eliciting values in situations where environmental changes involving large numbers of attributes are being evaluated

(Mitchell and Carson 1989). Direct methods have been extensively used to value a broad range of environmental features and services, with the contingent valuation method being most commonly employed to date. Other direct methods include modifications of or departures from the fundamental contingent valuation method (in addition to methods discussed below see, for example, Duke and Aull-Hyde 2002, Sagoff 1998, Wilson and Howarth 2002).

"Ask a hypothetical question, get a hypothetical answer" is the most common criticism of stated preference methods; that is, that respondents' willingness or ability to answer questions truthfully and carefully is dubious, and calls into question the efficacy of direct valuation methods. Manski (2000) however, counters that surveys are often the most effective way to understand people's preferences, and that well-designed surveys can overcome many of the problems identified by objectors to the method.

By presenting individuals with hypothetical markets in which they have the opportunity to purchase public goods, the contingent valuation method is aimed at eliciting their WTP in dollar amounts. Contingent valuation uses survey questions to elicit people's preferences for public goods by finding out what they would be willing to pay for specified improvements in them. The contingent valuation format may be open-ended, in which consumers are asked the maximum they are willing to pay for a given change in a public good. Alternately, consumers may be presented with the choice of purchasing a public good at a given price, an approach known as dichotomous choice (van Kooten and Bulte 2000).

Choice experiments

Choice experiments are based in random utility theory, have certain advantages over CV methods, and have been used in the evaluation of both use and nonuse values. The method is similar to contingent valuation, but instead of presenting a choice between a base case and a single alternative, choice experiments present decision makers with a set of alternatives representing possible outcomes. The set of alternatives is made up of a bundle of goods possessing specific attributes at designated levels (above or below status quo levels), and includes a price component. A key feature of the method is that the choice sets presented to respondents are similar to decision-making situations involving attribute trade-offs commonly encountered by respondents, and as such presents respondents with a familiar cognitive task.

Adamowicz et al. (1998) and Hanley et al. (1998 and 2001) identify a number of advantages of choice experiments over contingent valuation methods. Choice experiments allow for the partitioning of utility into its component parts, thus permitting the estimation of the value of individual attributes that make up an environmental good rather than consideration of the good as a whole. Choice experiments also allow for tests of internal consistency as a result of repeated choices, and likely reduce embedding problems associated with contingent valuation studies. Finally, choice experiments simplify the respondents' cognitive task where alternatives are composed of several attributes by presenting those attributes in a format consisting of a choice between alternative scenarios.

Although widely utilized in the marketing and transportation fields and generally well accepted as methods for eliciting consumer preferences for alternatives with

multiple attributes (Louviere 1988, 1992 and Louviere et al. 2000), choice experiments have only recently been applied to the valuation of nonmarket environmental goods and services. Since their introduction to the environmental valuation field, choice experiments have been used to evaluate public preferences for a wide range of environmental topics (Table 5-2).

Much work thus far has focused on validating the efficacy of choice experiments by comparing their results with those of alternate methods, either stated or revealed. The first application of choice experiments to environmental valuation was Adamowicz et al. (1994) in a survey of preferences for recreational alternatives. The study allowed for a comparison of revealed and stated preferences for the same amenities, and concluded that although the welfare measures from the two methods differed, the

Table 5-2: Choice experiment studies in environmental valuation.

Reference	Study subject	Instrument administration	Number of attributes[a]	Number of alts. per choice set[b]	No. of choice sets / choice sets per instrument	Total usable responses
Adamowicz et al. (1994)	Freshwater recreation	Mail survey with phone contact	10,11	2	64/16	413 (53%)[c]
Boxall et al. (1996), Adamowicz et al. (1997)	Moose hunting	Group meeting	6	2	32/16	271
Adamowicz et al. (1998)	Caribou habitat enhancement	Mail survey with phone contact	5	2	32/8	355 (39%)
Bullock et al. (1998)	Deer hunting	Mail survey	5	2	12/6	854 (45%)

Table 5-2: Continued

Reference	Study subject	Instrument administration	Number of attributes[a]	Number of alts. per choice set[b]	No. of choice sets / choice sets per instrument	Total usable responses
Hanley et al. (1998)	Forest landscape preferences	Personal interviews	3	2	4/4	181
Milon et al. (1999)	Everglades restoration preferences	Personal interviews	6	2	14(x2)/7	453 (219+234)
Boyle et al. (2001)	Forestry practice preferences	Mail survey	8	4	n.a.[d]/1	295 (42%)
Àlvarez-Farizo and Hanley (2002)	Wind farm environmental impact preferences	Personal interviews	4	2	4/4	488
Srethsa and Alavalapati (2003)	Silvopasture practice preferences	Mail survey with phone contact	4	2	12/6	152 (32%)
Bauer et al. (2004)	Wetland mitigation preferences	Personal interviews	4	2	32/2	289
Present study	Ecosystem service and conservation preferences	Mail survey	4	2	27/9	945 (19%)

[a] includes cost attribute
[b] all choice sets also include a status quo, or opt out, alternative, except Milon et al. (1999).
[c] response rate for mail surveys in parentheses, in the case of studies employing an initial phone contact, the response rate reflects the percent of usable responses based on the total number of individuals who agreed to receive the questionnaire.
[d] choice sets composed of randomly assigned levels of each attribute, each questionnaire different.

underlying preferences reflected in both models were similar. Boxall et al. (1996) found WTP values derived from a choice experiment to be much lower compared to those derived from a contingent valuation. The authors felt that design flaws in the contingent valuation survey instrument confounded the results, however. Hanley et al. (1998) found preferences derived from a choice experiment evaluating use values to be similar but WTP to be somewhat higher compared to results from an open-ended contingent valuation survey. Adamowicz et al. (1998) compared contingent valuation and choice experiment methods in an evaluation of woodland caribou habitat enhancement alternatives, a passive use valuation, and found that preferences and welfare measures estimated by the two approaches were not significantly different.

Two comparisons of the choice experiment format with other members of the "conjoint analysis family" have been undertaken. Boyle et al. (2001) found that ratings, ranks, and choice experiments provided welfare estimates that differed up to one third in a study of preferences for forest management practices. Alvarez-Farizo and Hanley (2002) found that choice experiments gave estimates of WTP to prevent environmental damages up to 50% greater than did contingent ranking.

In summary, preferences derived from choice experiments tend to be the same or very similar to those derived from other methods used in environmental valuation. Choice experiments generally provide WTP estimates that are either not significantly different or within a reasonable range from those derived from other methods. While some questionable results are noteworthy, the apparent methodological validity relative to other nonmarket valuation techniques combined with a number of advantages of the

choice experiment format make it useful tool for environmental valuation studies such as the present work.

CHAPTER 6
METHODS

Survey Design and Implementation

A mail survey was selected as the most appropriate method to collect data given budgetary constraints and the need to convey a large amount of complex information to respondents. The attributes presented in the survey instrument were defined by the objectives of the study: the determination of preferences and willingness to pay for different ecosystem services and protection mechanisms. This resulted in the four attributes presented in the survey instrument: protection plan scale (identified as quantity of land in questionnaire); focus of the protection scenario (i.e., targeted ecosystem service); type of protection offered (i.e., purchase v. less than fee simple); and household cost (Table 6-1).

Table 6-1: Summary of attributes and attribute levels

Attribute	Levels	Description
Quantity of land	1) 10,000 acres 2) 100,000 acres 3) 250,000 acres	The amount of land included in a given protection plan.
Focus of protection plan	1) Water quality and quantity 2) Wildlife habitat 3) Open space	The main focus of the preservation effort.
Type of protection	1) All fee-simple 2) ½ fee-simple, ½ cooperative agreements 3) All cooperative agreements	Mechanism for protecting land in a plan.
Cost	1) $5/year 2) $25/year 3) $50/year	The cost per household per year.

The quantity attribute levels were determined by considering the 1995 land use data provided by the St Johns River Water Management District (1999). The district reports a 1,476 sq. mi. (944,640 acres) area dedicated to agriculture, forestry, and terrestrial natural habitats. The total area of these land uses approaches one million acres, and the lowest attribute level represented the protection of 1% of this area, or 10,000 acres. The upper bound for the attribute similarly corresponded to approximately 25% of the area, 250,000 acres, while 100,000 acres was chosen as an intermediate value.

The program focus attribute was based on three ecosystem services of concern to the state of Florida in general and the Northeast region in particular: water quality and quantity, wildlife habitat, and open space provision. The provision of water, in terms of quality and quantity, for consumptive use (e.g., drinking water, water bodies used for recreation, etc.) as well as the service of flood control was contemplated in the first attribute level. The wildlife habitat level referred to maintenance of biological and genetic diversity resulting from the provision of suitable refugia and breeding habitat for plants and animals. The open space level referred to residents' enjoyment of the scenic character of attractive landscapes, and the heritage value of these ecosystems.

The protection type attribute sought to assess respondents' preferences with respect to different conservation strategies enabling natural and agricultural lands to be protected, namely fee simple purchases or conservation easement or lease agreements, described as "cooperative agreements" in the questionnaire. The three levels representing the conservation strategies were either fee simple purchase of all land in the plan, implementation of cooperative agreements for all land in the plan, or an equal share of the land in fee simple purchases and cooperative agreements.

The cost attribute referred to the cost per household of a given alternative whose upper bound of $50 per household, when multiplied by the number of households approximates the price of 250,000 acres in the four-county region based on average assessed land values. Lower household cost levels were chosen as intermediates between the lower bound of $0, i.e., the status quo option, and the upper bound.

Unlike most surveys of this nature the cost attribute was not described in terms of a tax increase. Since less than fee simple agreements could be financed, at least in part, by property tax rebates and the like, portraying the cost of a given alternative explicitly in terms of a household tax increase is not appropriate. A relatively generous assumption was inherent in this presentation: that respondents would understand that although a tax increase is not explicitly being proposed, funds for an alternative do come from the government budget, and that the budget would need to be adjusted in response to the implementation of a given plan.

Inasmuch as it decreases respondent fatigue and increases response rates, brevity in both the amount of text contained and the number of choice sets is desirable in the design of the survey. This must be balanced with both the need to adequately convey at least a minimum of the situation's complexity to the respondent and to collect sufficient data to satisfy the survey objectives. Textual content was therefore supplemented with appropriate graphics in order to save on verbiage. A general rule that respondents should be presented with no more than ten choice sets was used as an upper bound during instrument design (DeShazo and Fermo 2002, Milon et al. 1999).

A fractional factorial design was employed given the instrument length constraint and the objective of evaluating four separate attributes since even a limited number of

attributes with only a few levels result in large numbers of combinations in a full factorial experiment. Four attributes with three levels each resulted in 3^4, or 81, possible attribute-level combinations, and 3^4 x 3^4, possible combinations in a paired choice design. 27 balanced orthogonal profiles of the attribute levels were identified and then paired into 27 choice sets using SAS version 8. The autocall macro *%mktdes* was applied to the profiles whose pairing in choice sets was optimized to minimize the variance of parameter estimates (Kuhfeld 2001, Kuhfeld et al. 2001). SAS code used to optimize choice sets pairings is included in Appendix A; choice set pairings used in the study are reported in Appendix B.

The design was resolution III (main effects not aliased with other main effects, but aliased with two-factor interactions), and contained a reasonable number of sets when split into three versions of the instrument, i.e., nine choice sets per questionnaire. The 27 choice sets were randomly assigned to one of the three versions of the survey instrument. Thus all respondents were presented with nine choice sets, receiving an identical questionnaire, save for the differing levels of attributes in the three versions.

The survey instrument consisted of four parts: an introduction to the topic and survey, a preliminary protection plan focus question, choice task instructions and a series of nine choice tasks, and finally a respondent demographic and socioeconomic section. The introduction explained why some people value natural and agricultural lands, as well as providing an indication of their economic importance. It followed with a brief description of the attributes, and includes maps of the region indicating extant natural landscapes and agricultural areas, as well as priority areas for protection.

Preceding the instructions for the choice sets and the choice task itself, an initial question regarding the respondents' preference for the ecosystem service focus of a hypothetical regional protection plan was included. The question was incorporated in response to a number of reviewer remarks indicating confusion about how to select a focus given that the services provided by a given land parcel are not mutually exclusive. That is, the fact that land set aside for wildlife habitat also provides a measure of water quality and quantity provision, in addition open space. We hoped that the explicit recognition of the overlapping functions of land in this preliminary task would clarify the choice task.

Instructions for filling out the survey were included in the next section, followed by the series of choice tasks where respondents are presented with two plans consisting of varying levels of the four attributes. The choice sets were presented in a referendum format, where the respondent marked a box indicating their preferred plan. For each choice set, respondents were also given the option of choosing neither plan, the status quo option. This baseline alternative need be included since one of the alternatives must always be in the respondent's feasible choice set in order to be able to interpret the results in standard welfare economic terms (Hanley et al. 2001).

Version C of the questionnaire contained a typographical error in one attribute level for one alternative. The quantity attribute for Plan A read: "250,000 acres (10% of existing land)," where the percentage should have read "25% of existing land." The error does not appear to have affected response rate of this version, and only two respondents noted the discrepancy. Given that the error was embedded in the middle of the

description, the analysis of responses makes the assumption that respondents correctly interpreted the attribute level.

The final portion of the survey instrument consisted of a series of questions in which respondents indicate their demographic and socioeconomic characteristics. Standard demographic (sex, age, education, residency status, household size) and socioeconomic (household employment and income, home ownership) information was solicited from respondents for comparison with the overall population of the region and state and to examine effects on conservation preferences. One inquiry regarding land ownership was included to test for the possible difference in response on the part of respondents who might conceivably be eligible for participation in such a hypothetical plan. Voting habits were also included in this final section as an indicator to public officials and other interested groups of voter support for initiatives such as the hypothetical one described in the questionnaire.

The survey instrument was accompanied by other documents intended to inform respondents about the purpose of the survey and generate interest in their completion of the questionnaire, largely following Dillman's Tailored Design Method (2000). Respondents received a preliminary notification letter prior to receiving the questionnaire, a cover letter in the same mailing as the questionnaire, a reminder postcard shortly after reception of the questionnaire, and finally a replacement questionnaire with its own cover letter. Business reply mail return envelopes were provided with the questionnaire mailings. A copy of correspondence sent to respondents is included in Appendix C.

Various developmental stages of the survey questionnaire were evaluated by a total of approximately 50 individuals of diverse backgrounds. Reviewers included faculty members experienced in survey methods and implementation, students, and members of the general public. Relevant remarks were incorporated into the final instrument design.

The Marketing Systems Group of Genesys Sampling Systems generated a list of 5,000 randomly selected residents in the four-county region based on telephone directory listings; all names on the list were sent the series of mailings via first class mail. Respondents were not identified in any way during the mailing and return of questionnaires, and therefore all received the entire series regardless of whether they had completed the first questionnaire received. The preliminary notification letter was sent on March 22, 2004 and the final mailing of the replacement questionnaire took place on April 26, 2004. Completed questionnaires were received until June 11, 2004.

Statistical Modeling of Choices

Let *G* represent the set of alternatives in a global choice set, while *S* is the set of vectors of measurable characteristics of decision-makers. Each individual has some attribute vector $s \in S$, and is presented with some set of available alternatives $A \subseteq G$. The actual choice of an individual with attributes *s* and the set of alternatives *A* can be defined as a draw from a multinomial distribution with selection probabilities as $P(x \mid s, A) \;\; \forall x \in A$. That is, the probability of selection alternative *x* for each and every alternative contained in the set *A*, given an individual's socioeconomic background and set of alternatives *A*.

Choice experiment models employ the theoretical framework of random utility theory, which postulates that an individual's utility U_{iq} (utility of the *i*th alternative for the *q*th individual) can be segregated into two components – a systematic or deterministic component, V_{iq}, and a random component reflecting individual preferences, ε_{iq}:

(6-1) $$U_{iq} = V_{iq} + \varepsilon_{iq}.$$

The systematic component of the function, V_{iq}, is assumed to be the portion of an individual's utility resulting from the individual's attributes observed by the analyst. This component is assumed to be homogenous across the population, unlike the contribution of an individual's unobserved attributes, the random component ε_{iq}. The term "random" is applied not because individuals behave in random fashion to maximize utility, but rather because of the observational limitations of the analyst. Since the analyst cannot truly delve into an individual's choice calculus, the best he can do is to assign a probability of alternative selection in explaining choice behavior.

We assume that individuals will select alternatives that provide the greatest utility, choosing alternative *i* if and only if:

(6-2) $$U_{iq} > U_{jq} \quad \text{for all } j \neq i \in A;$$

or, as framed within the random utility format:

(6-3) $$V_{iq} + \varepsilon_{iq} > V_{jq} + \varepsilon_{jq}.$$

Rearranging to combine the observable and unobservable elements results in

(6-4) $$\varepsilon_{jq} - \varepsilon_{iq} < V_{iq} - V_{jq}.$$

V_{jq} is a conditional indirect utility function with linear, additive form that maps the multidimensional attribute vector X into a unidimensional overall utility:

$$V_{jq} = \beta_{j1}x_{j1q} + \beta_{j2}x_{j2q} + \beta_{j3}x_{j3q} + \cdots + \beta_{jk}x_{jkn} = \sum_{k=1}^{K} \beta_{jk}X_{jkq} \ . \tag{6-5}$$

Due to the aforementioned observational limitations, the inequality cannot be evaluated in practice, and therefore the analyst must rely on the probability of choice, in essence determining the probability that the equality holds. This leads to:

$$P(x_{iq}) = P_{iq} = P[\{\varepsilon_{jq} - \varepsilon_{iq}\} < \{V_{iq} - V_{jq}\}; \forall j \in A_q] \ . \tag{6-6}$$

That is, the probability that individual q, described by attributes s and presented with choice set A, will select alternative x_i equals the probability that the difference between the random utility of alternatives j and i is less than the difference between the systematic utility levels of i and j for all alternatives in the choice set.

Heckman Two-Step Estimation

One way to derive estimates of choice probabilities is the sample selection method. The sample selection method provides information about two decisions that respondents inherently make in the choice experiment: whether to participate or opt out (i.e., to choose one of the two conservation alternatives versus the neither alternative), and then which alternative to choose once the decision to opt in has been made. The parameters of the sample selection model are generally estimated using Heckman's (1976) two-step estimation procedure.

The general framework of the sample selection model is as follows (Greene 2003): the equation defining sample selection is

(6-7) $$z_i = \mathbf{W}\gamma_i + u_i$$

while the equation defining the choice of alternative conservation plans for respondents opting in is

(6-8) $$y_i = \mathbf{X}_i\beta + \varepsilon_i$$

where **W** and **X** are vectors of alternative attributes and/or demographic characteristics of respondents, γ and β are their corresponding coefficients. The sample rule is that y_i is observed only when z_i>0. Assuming that error terms ε_i and u_i have a bivariate normal distribution with zero means and correlation ρ, the model can be reformulated as

(6-9) $$\begin{aligned} &\mathrm{P}(z_i = 1 |\ \mathbf{W}_i) = \Phi(\mathbf{W}_i\gamma) \text{ and} \\ &\mathrm{P}(z_i = 0 |\ \mathbf{W}_i) = 1 - \Phi(\mathbf{W}_i\gamma) \end{aligned}$$

(6-10) $$\begin{aligned} &y_i = \mathbf{X}_i\beta + \varepsilon_i \\ &\quad \text{if } z_i = 1 \end{aligned}$$

where $\Phi(.)$ indicates the standard normal equation. Alternately:

(6-11) $$E[y_i |\ z_i = 1, \mathbf{X}_i, \mathbf{W}_i] = \mathbf{X}_i\beta + \rho\sigma_\varepsilon\lambda(\mathbf{W}_i\gamma)$$

where

$$\lambda = \frac{\phi(\mathbf{W}_i\gamma / \sigma_u)}{\Phi(\mathbf{W}_i\gamma / \sigma_u)},$$

known as the inverse Mills ratio.

The Heckman procedure employs a probit estimation to obtain parameter estimates for participation, γ, then estimates the parameters of the conservation alternative selection, β, and $\beta_\lambda = \rho\sigma_\varepsilon$ using the conditional logit. Maximum likelihood estimation is used in both steps of the method, and the two steps are tied together by the

inclusion of the inverse Mills ratio as an explanatory variable in the conditional logit model.

The probit model takes the form

(6-12) $$P(z_i = 1 | \mathbf{W}) = \int_{-\infty}^{\mathbf{W}'\gamma} \phi(t)dt = \Phi(\mathbf{W}'\gamma)$$

where **W** is a vector of attributes of the choice alternatives and/or demographic characteristics of respondents.

The probability of selecting alternative *i* is determined using the conditional logit model, as follows:

(6-13) $$P(y_i = 1 | z_i = 1, \mathbf{X}_i, \mathbf{W}_i) = \frac{\exp(\mathbf{X}\beta + \beta_\lambda \lambda)}{1 + \exp(\mathbf{X}\beta + \beta_\lambda \lambda)}$$

where **X** is a vector of alternative attributes and/or demographic characteristics of respondents. Attributes used in the probit estimation (**W**) can be the same as those used in the conditional logit estimation (**X**) since the probit estimation is highly nonlinear (Long 1997).

Demographic and socioeconomic variables specific to individual respondents cannot be examined directly in the conditional model because these variables do not vary across alternatives. Nevertheless individual-specific variables can interact with alternative-specific attributes to provide some identification of attribute parameter differences in response to changes in individual factors. While the approach is simple it can result in a model specification with a large number of variables and potential collinearity problems. In practice the individual-specific factors to be interacted are limited, which makes the assumption that the analyst knows the factors resulting in heterogenous preferences (Swallow et al. 1994).

Dummy variables known as alternative-specific constants (ASCs) capture the utility of an alternative not captured by the attributes in the model (Adamowicz et al. 1997). That is, the utility of alternative *i* can be modeled as a function of attribute vector *X* and an ASC:

$$V_i = ASC_i + \beta X_i . \tag{6-14}$$

Since ASCs are not tied to specific attributes they do not explain choice in terms of observable attributes. ASCs therefore improve model performance but cannot be easily used in predicting the effect of changes in attribute levels.

If a choice experiment contains an opt-out alternative, ASCs must be included in the model specification in order to capture the utility associated with the status quo alternative, which generally has no attributes. The ASC can be specified as either associated with the opt-out alternative or an ASC can be assigned to each of the alternative scenarios presented in the choice set.

Coding of quantitative variables in the statistical estimation of parameters is straightforward since the attribute level is a quantity. Qualitative attributes however, must be coded. This can be done using sets of dummy variables where one category is designated as a "base" level and its effect is captured in the intercept term. In stated preference models however 1,0 dummies confound the alternative specific constant, and thus no information is recovered about preferences regarding the omitted level (Adamowicz et al. 1994, Louviere et al. 2000). This limitation is overcome using effects codes wherein the "base" level of the attribute is assigned –1 in the coding matrix and each column contains a 1 for the level represented by the column. Under this coding

scheme the base level parameter takes on the utility level of the negative sum of the estimated coefficients and each other level takes on the utility associated with the coefficient.

Welfare Measure Determination

The utility associated with the status quo situation, V^0, presented in a choice experiment must be determined in order to make an evaluation of the monetary value of changes to the attributes being evaluated. V^0 can be simplified to include only the elements of cost and a generic quality factor Q^0:

(6-16) $$V^0 = \mu_1(\text{cost}) + \mu_2(Q^0).$$

If a positive change in quality from Q^0 to Q^1 is proposed, and we assume that $\mu_1 < 0$ and $\mu_2 < 0$, the welfare impact of the change is the cost increase in the new scenario that makes a person as well off as they were in the original situation. We can thus determine the compensating variation (CV), or the amount of money that equates the original utility level V^0 to the utility resulting from the quality improvement V^1:

(6-17) $$V^0 = \mu_1(\text{cost}) + \mu_2(Q^0) = \mu_1(\text{cost} + CV) + \mu_2(Q^1) = V^1.$$

A willingness-to-pay compensating variation welfare measure that conforms to demand theory can be derived for each attribute once parameter estimates have been obtained. Compensating variation is the quantity of money that equates the original utility level (V^0) with the utility associated with the proposed alternative (V^1). Hanemann (1984) developed the following formula to determine this difference:

(6-18) $$WTP = -\frac{1}{\mu_c}\left[\ln\sum_{i=1}^{n}\exp(V_i^0) - \ln\sum_{i=1}^{n}\exp(V_i^1)\right]$$

where μ_c is the marginal utility of income, obtained in the MNL model as the coefficient of the cost attribute. Using the coefficients of any of the attributes (μ_j), the *WTP* function can be simplified into a ratio:

$$WTP_j = \frac{-\mu_j}{\mu_c}. \tag{6-19}$$

This is the part-worth utility indicating the marginal value of a change in an attribute, or the marginal rate of substitution between changes in income and the attribute in question.

Since *WTP* is a nonlinear function of the parameter estimates μ, a linear approximation of *WTP* is likely a poor estimation of its distribution. Krinsky and Robb (1986) have developed a method for simulating the distribution of such coefficients that involves taking repeated random draws from the multivariate normal distribution defined by the parameter estimates and their associated variance-covariance matrix. An empirical distribution is thus generated for WTP, from which confidence interval estimates can be calculated.

CHAPTER 7
RESULTS AND DISCUSSION

Indicators of Instrument Quality

A total of 945 (19% survey response rate) usable responses were received over 11 weeks; 284, 345, and 316 of forms A, B, and C, respectively, were returned. While substantially less than the response rate reported by some of the other mail surveys in Table 5-2, this survey was generally lengthier, not accompanied by an initial telephone contact, and not administered to an interest group such as hunters. The response rate for the questionnaire is on the high end of the typical range reported by other university researchers for mail surveys in Florida.

The completion rate for individual questions within the instrument provides an indication of the clarity and coherence of the instrument's format. Figure 7-1 reports the completion rate for all instrument questions aside from the choice sets themselves, in the order that they appeared in the questionnaire (note that the preliminary focus question was positioned before the choice sets, while all others appeared on the final page of the instrument). Nearly all respondents provided the full suite of socioeconomic and demographic information; the approximately three percent unanswered for the majority of the questions is accounted for by respondents who left the entire final page blank. Given their willingness to answer all other questions, many respondents presumably overlooked the number of years as resident question that was embedded in a second line of text. As might be expected, respondents demonstrated the greatest reluctance to

identify their household income. The high completion rate for nearly all questions indicates that the format of this portion of the questionnaire was clear and intelligible.

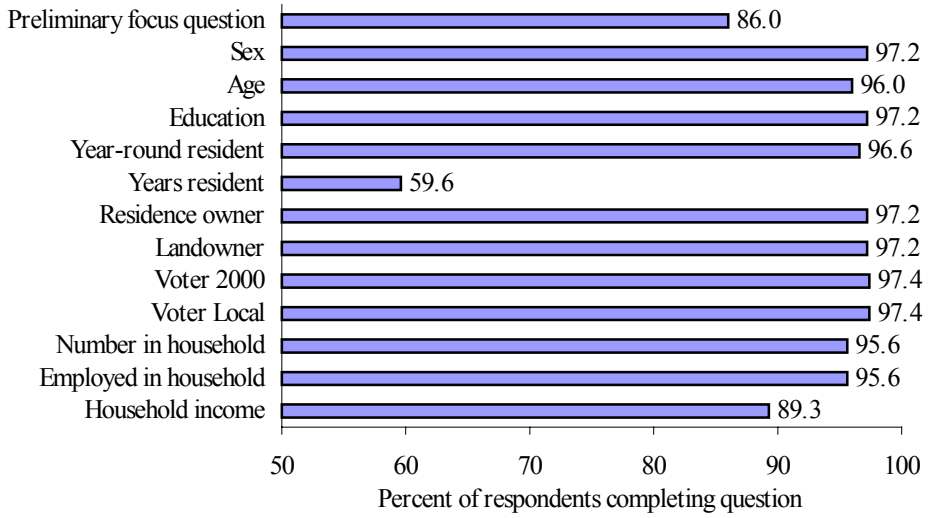

Figure 7-1: Completion rate for instrument questions outside choice sets.

It is assumed that respondents put thoughtful consideration into the selections made in the choice sets. One way to evaluate this assumption is to examine the number of times that a given respondent selected to "do something" versus "doing nothing," that is, whether respondents chose one of the plans presented versus choosing the opt out, or neither, option. Just over half of respondents chose to opt in on all choice sets; 6.9% of respondents chose to opt out for all nine choice sets (Figure 7-2). The percentage of respondents that chose to opt out between one and eight times (37.5%) supports the view that most respondents did not universally accept nor reject the inherent desirability or undesirability of the hypothetical conservation plans as a general principle, but rather considered each case individually based on its attribute levels.

Based on the underlying concepts of the methodology, respondents should consistently manifest their preferences for attribute levels via their choices throughout a given survey instrument, and this consistency should hold

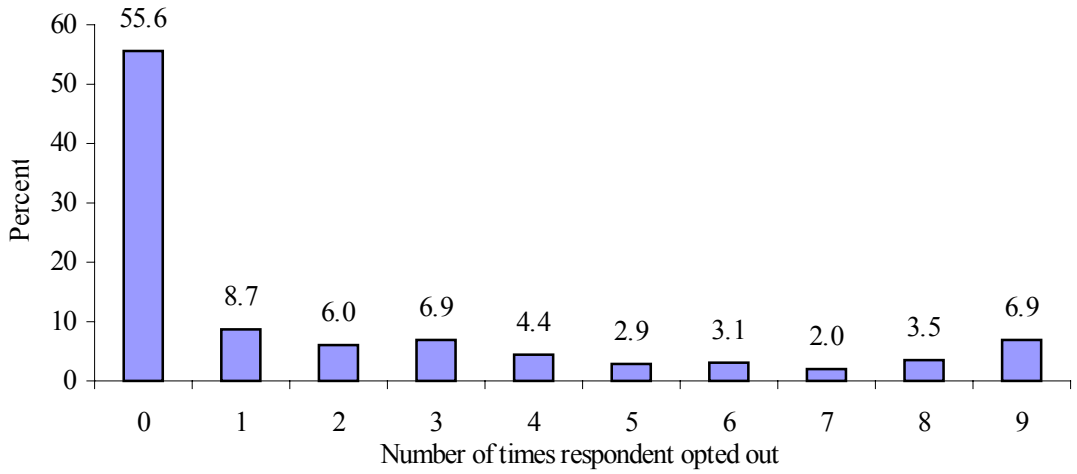

Figure 7-2: Opt out selections of respondents.

when the same preferences are elicited in varying formats. Inconsistency across formats may be an indicator that respondents did not give the same consideration to information presented in the different formats, and as such points to a problem of instrument design.

The present instrument provides an opportunity to test whether the respondents demonstrate this consistency in preferences between an inherently simple format, the preliminary focus attribute question, and the choice sets themselves, the second, more complex format. If the selections in the relatively more complex choice sets reflect respondent preference as simply stated in the preliminary question, then we can conclude that the presentation of information in the complex format was appropriate.

Using all responses for which the preliminary focus question was completed, and evaluating all choices within this set where one of the alternative plans was selected (i.e.

the respondent did not opt out), a correlation matrix can be constructed that indicates the consistency of choices across formats (Table 7-1). A value of 1 for correlation of the same attribute level across formats would indicate perfect correlation, i.e. perfect choice consistency across formats, but since all levels for the focus attribute are not present in all choice sets (only approximately 2/3 of the pair-wise choices overlap), the value here will always be less than one. Furthermore, respondents hold preferences for the other attributes presented within a given plan, which affects their choice and further pushes the value of the same-attribute-level correlation downward. Nevertheless, the sign of pair-wise correlations and their relative magnitude do provide a measure of consistency.

For all attribute levels the correlation of each attribute level with itself across formats is positive in all cases (versus negative values for all other pair-wise correlations) and of greater magnitude. Thus respondents demonstrated consistency in their preferences across formats, which in turn argues for the adequacy of the presentation of the focus attribute within the choice sets.

Table 7-1: Correlation matrix for preliminary focus question and selected plans (n=6655).

	Focus attribute level in selected plan		
Preliminary question choice	Water	Wildlife	Open space
Water quantity and quality	0.2666	-0.1688	-0.1228
Wildlife habitat	-0.1829	0.1964	-0.0004551
Open space preservation	-0.1483	-0.001524	0.1687

Respondent Profile

The socioeconomic and demographic profile of respondents differed substantially from the study region's population; selected characteristics of the sample population are reported in Table 7-2. The sample population was made up of a greater percentage of voters compared to statewide averages of 70% and 55% turnout for 2000 presidential and

2002 midterm elections, respectively (Florida Division of Elections 2004). Respondents were also disproportionately male and older than the region's typical resident (Figure 7-3). Household income was also somewhat higher in the sample population compared to the mean household income in the region of approximately $67,000 (Figure 7-4).

Table 7-2: Characteristics of survey sample population.

Characteristic	% of respondents	n
Male	65.5	919
Year-round resident	99.3	913
Residence owner	89.9	918
Landowner	4.1	919
Voter 2000	88.7	919
Voter local	85.5	920

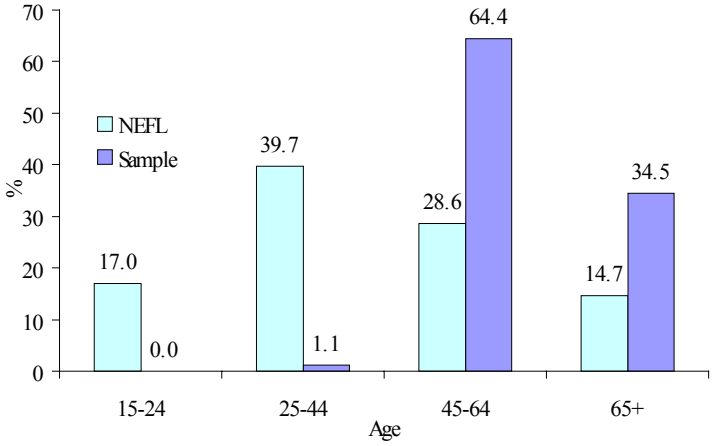

Figure 7-3: Age profile of sample population and Northeast Florida residents.

Note: Histograms for Northeast Florida based on portion of population over age 14.

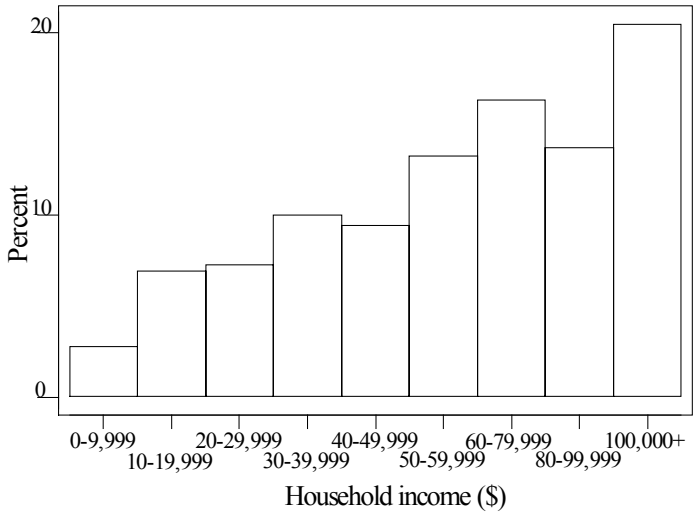

Figure 7-4: Household income distribution for survey sample population.

Sample Selection First-Step Results

The selection of individual-specific attributes for inclusion in the probit estimation was based on sufficient variation in their values, as well as their explanatory power. The probit estimation included individual-specific attributes for which sufficient variation was present. Thus, for example, residency was not included since only four individuals in the sample indicated that they were nonresidents. While data were obtained for five and nine levels of education and income, respectively, estimation with all levels provided little insight into their contribution to preferences. Income and education were therefore aggregated into low and high categories, with the high income category including respondents with household income of $60,000/yr. or greater, and high education including respondents with a bachelor's or advanced degree. Data were analyzed using TSP version 4.4 software; the code used for analysis is included in Appendix C.

Parameter estimates derived from the first-step probit model reveal that both individual- and alternative-specific attributes influence the decision to select a conservation alternative or opt out (Table 7-3). Coefficients for both acreage and annual cost were highly significant, although the positive sign of the cost coefficient is opposite what would be expected, indicating that higher annual cost increases the probability of the decision to opt in. Landowners and relatively older respondents were significantly more likely to opt out; respondents in the higher income group were significantly less likely to opt out.

One might expect that the decision of whether to participate or not, i.e. the first step in the estimation, might depend to a greater degree on individual-specific attributes. Nearly one third of all opt out choice sets (585 of 1852) in the sample were contributed by respondents who chose to opt out in all nine choice sets. Although it appears that most respondents gave careful consideration to the choices at hand in the selection of preferred alternatives, as indicated in Figure 7-2, the degree of consideration by the group of respondents who opted out in every choice set is questionable. The decision to opt out on the part of these respondents in many cases may have had nothing to do with the attribute levels present in the choice sets, but rather participation was rejected as a general principle. This is supported by the anti-government pejoratives often included in the remarks section in many of this group's questionnaires. Since alternative-specific attributes likely did not enter into the choice calculus of such a large portion of the opt out responses, it is less surprising to find coefficients for these attributes contrary to expectations. The decisions by the group that opted out across the board may thus explain the positive coefficient on the cost parameter in the probit model that runs

counter to basic economic intuition and theory. It may also explain the change of sign from negative to positive from the first to the second estimation step in the case of the protection type attribute level of half purchase/half cooperative agreement.

Table 7-3: Maximum likelihood estimation coefficients for probit model.

Parameter	Estimate	SE	t-statistic	P-value
Water qual. and quant. (base)	0.057130	-	-	-
Wildlife habitat	-0.043240	0.0157240	-2.7498	[0.006]
Open space	-0.013890	0.0156920	-0.8851	[0.376]
All purchase (base)	0.092918	-	-	-
Half purchase/half coop. agrmt.	-0.075735	0.0159400	-4.7512	[0.000]
All coop. agrmt.	-0.017183	0.0156630	-1.0971	[0.273]
10,000 ac. (base)	0.002933	-	-	-
100,000 ac.	-0.071178	0.0159370	-4.4662	[0.000]
250,000 ac.	0.068245	0.0156500	4.3606	[0.000]
Annual cost	0.025385	0.0004838	52.4658	[0.000]
Male	-0.007235	0.0096095	-0.7529	[0.452]
Residence owner	-0.014848	0.0155700	-0.9536	[0.340]
Landowner	-0.068813	0.0211690	-3.2507	[0.001]
High education	-0.000545	0.0109500	-0.0498	[0.960]
High income	0.031063	0.0097928	3.1721	[0.002]
Age	-0.001940	0.0006360	-3.0510	[0.002]
Constant	-0.105022	0.0411720	-2.5508	[0.011]
Number of observations[a]:	22,383			
Log likelihood:	-13530.6			
Likelihood ratio:	3066.77 [.000]			
R^2:	.140575			
Scaled R^2:	.134544			

[a] Number of observations for the probit model equals 3 times the total number of choice sets being evaluated, 7461.

Individual-specific attribute parameter estimates in the probit model are largely as expected. A negative coefficient for males and positive coefficient for the higher education group, although neither is statistically significant, are consistent with results from other valuation studies, as is the positive coefficient for the higher income group.

The negative coefficient and relatively large weight associated with land ownership may reflect the undesirability of the imposition of land-use restrictions of any sort. Voluntary participation in conservation alternatives on the part of landowners was taken as a given in development of the survey, but never explicitly stated as such in the instrument. Based on a handful of remarks on returned questionnaires (e.g. "I don't think that people should be told what to do with their land"), it appears that some people were left with the impression that conservation agreements or purchases could be carried forward against the will of landowners. It is unclear how many respondents were left with this impression, but landowners would presumably be the most sensitive to such an interpretation, which may explain the parameter estimate.

Sample Selection Second-Step Results

The second-step conditional logit estimation indicates that all attribute levels were highly significant in affecting choice probability between alternative plans (Table 7-4). Signs are largely as expected, including a negative weight on the cost attribute. Socioeconomic and demographic variables were not included in the logit estimation since their contribution to choosing between the two alternative plans is of limited usefulness.

The alternative-specific constant, ASC1, is a measure of utility resulting from factors other than the alternative-specific attributes. It is not statistically significant, indicating that respondents did not derive a greater level of utility from either of alternative plans in the choice sets.

The most important attribute factoring into respondents' choices is the alternative plan's focus. Respondents demonstrated that plans focusing on the provision of water quality and quantity were most desirable (coefficient of 0.4292 greater than all others). The provision of water in the face of population growth statewide is an important

environmental issue that continually receives a great deal of media coverage, which is likely reflected in respondents' choices. Respondents placed little importance on open space provision. Urban residents might be expected to show stronger preferences for open space. Since the sample was not stratified, it is likely that a relatively large portion of responses came from urban residents, although this is speculative because respondents were not individually identified and this information was not solicited. In any case, this was by far the least preferred alternative focus, somewhat surprising given the degree of land use change projected for the region, and St Johns county in particular. Parameter estimates agree with the response to the preliminary focus question, where 532 respondents chose water quality and quantity, 169 chose wildlife habitat, and 112 chose open space.

Table 7-4: Maximum likelihood estimation coefficients for logit model.

Parameter	Estimate	SE	t-statistic	P-value
Water qual. and quant. (base)	0.429292	-	-	-
Wildlife habitat	-0.087346	0.023081	-3.7843	[0.000]
Open space	-0.341946	0.024070	-14.2066	[0.000]
All purchase (base)	0.084007	-	-	-
Half purchase/half coop. agrmt.	0.074658	0.024044	3.1050	[0.002]
All coop. agrmt.	-0.158665	0.023606	-6.7214	[0.000]
10,000 ac. (base)	-0.453838	-	-	-
100,000 ac.	0.067451	0.024957	2.7027	[0.007]
250,000 ac.	0.386387	0.024306	15.8965	[0.000]
Annual cost	-0.010578	0.001909	-5.5420	[0.000]
ASC1	-0.166507	0.136026	-1.2241	[0.221]
Inverse Mills Ratio	0.178050	0.246866	0.7212	[0.471]
Number of observations[a]:	5969			
Log likelihood:	-3688.10			
Likelihood ratio:	871.364 [.000]			
Scaled R^2:	.142971			

[a] Total number of choice sets for which respondents "opted in."

The conservation strategy of land purchases combined with conservation agreements was preferred to either strategy by itself, strongly so in the case of all cooperative agreements. This implies that respondents recognize the benefits of both types of protection, and find their combination to be a reasonable way to protect the service flows arising from the landscape. Several respondents made remarks (n<15) directly or indirectly referencing the protection type issue. These remarks included a few notes that hunting access to conservation lands was important, a few more indicating the respondent's desire to protect as many acres as possible, and two expressing the respondent's suspicion that conservation agreements would not benefit the public, but rather private landowners.

Willingness to Pay

Willingness to pay determination is a central objective of this study and its correct interpretation results from a careful examination of the experimental design. All estimated WTP values must be interpreted under the umbrella of some sort of conservation strategy, the components of which has four attributes. Thus the study's results do not answer the question, for example, "what is the worth to Northeast Floridians of three ecosystem services?" but rather "what is the WTP for a given conservation plan whose focus is one of the three ecosystem services being evaluated?"

The assignment of base levels to the quantity of land, plan focus, and conservation strategy attributes must also be taken into account in WTP interpretation. The 10,000-acre quantity of land, water quantity and quality provision, and the all purchase attribute levels were chosen as base levels. For the purposes of this study, base levels used in statistical estimation represent an attribute level describing the present condition against which other attribute levels are measured. The nature of this study

makes base level definition difficult, as there exists no overarching and uniform focus or strategy for implementing conservation plans in the region. Nevertheless it is possible to use the water quantity and quality provision and all purchase attribute levels as the base in this study. This is because of the strong institutional presence of the five Water Management Districts whose geographic coverage includes the entire state and whose activities have traditionally included land acquisition as a means to realizing their mandate. In a similar sense the all purchase conservation strategy has traditionally been the manner in which landscapes have been preserved. While none of these attribute levels perfectly fit a description of the current situation, their use as base levels in estimation is a practical approach.

Recalling that WTP values are relative to the base level, annual household WTP for conservation alternative attribute levels show a range of values both positive and negative (Table 7-5). Negative values associated with conservation plan focus attribute levels reflect residents' preference for conservation plan focus on water quantity and quality provision as the base level. A positive WTP value on the conservation strategy of half purchase-half conservation agreement level indicates a welfare gain for residents relative to the base level of all purchase.

Table 7-5: Annual household marginal willingness to pay for conservation alternative attribute levels.

Attribute level	Marginal WTP[a]
Wildlife habitat	-8.26
Open space	-32.33
½ purchase, ½ conservation agreements	7.06
All conservation agreements	-15.00
100,000 acres	6.38
250,000 acres	36.53

[a] WTP relative to base levels of focus on water, all purchase, and 10,000 acres.

Respondents' WTP for 250,000 acres is more than five times greater than their WTP for 100,000 acres. Economic theory posits that the marginal value of an acre of land under conservation plans would diminish as the amount of land in conservation plans increases. In terms of conservation value however, greater quantities of land often have greater value since many species of interest have large home ranges and as a result need large expanses of land for their survival. Furthermore larger land areas can sustain greater populations and thus aid in buffering the effects of ecological disturbances that can imperil small, isolated populations of plants and animals. While the study does not allow for an evaluation of this land scale issue, this result may indicate respondents' awareness of the conservation value of preservation of relatively larger tracts.

Summation of WTP values for the various attribute levels results in the annual household marginal WTP for the conservation alternatives presented in this study. Assuming that respondents are reasonably representative of the area population, multiplying the household values by Northeast Florida's 433,618 households results in a regional WTP for conservation alternatives (Table 7-6). The largest contributor to WTP is the greatest quantity of land, and nearly all conservation plans with this attribute level are positive. Maximum WTP is for the plan containing the most-preferred attribute levels: 250,000 acres with a focus on water and a mix of purchases and conservation agreements.

Table 7-6: Annual household and regional marginal willingness to pay for conservation alternatives.

	Annual marginal WTP ($/yr.)	
Attributes	Household	Region
100,000 acres		
Water, all purchase	6.38	2,764,981
Water, 1/2 purchase	13.43	5,825,394
Water, all coop agrmts.	-8.62	-3,739,084
Wildlife, all purchase	-1.88	-815,545
Wildlife, 1/2 purchase	5.18	2,244,869
Wildlife, all coop. agrmts.	-16.88	-7,319,610
Open space, all purchase	-25.95	-11,252,219
Open space, 1/2 purchase	-18.89	-8,191,806
Open space, all coop. agrmts.	-40.95	-17,756,284
250,000 acres		
Water, all purchase	36.53	15,838,945
Water, 1/2 purchase	43.59	18,899,358
Water, all coop agrmts.	21.53	9,334,880
Wildlife, all purchase	28.27	12,258,419
Wildlife, 1/2 purchase	35.33	15,318,833
Wildlife, all coop. agrmts.	13.27	5,754,354
Open space, all purchase	4.20	1,821,745
Open space, 1/2 purchase	11.26	4,882,158
Open space, all coop. agrmts.	-10.80	-4,682,320

Findings From Other Valuation Studies

A search of the environmental valuation literature did not yield any studies directly comparable to this work. Examples of studies valuing specific use and nonuse values are abundant, but this appears to be the first study that ties ecosystem service valuation to conservation strategies. One similar study examined preferences for wetland mitigation via preservation and restoration and found a household WTP for wetland restoration or preservation of $0.48/ac. (Bauer et al. 2004). The WTP value in the wetlands preference study is much greater than that found in the present work, but the differing context makes comparison difficult. For example, the marginal value of an acre

of wetland is likely much greater in the area of the Bauer study since wetlands make up a relatively smaller portion of the landscape there.

An Extrapolation: Conservation Efforts in Northeast Florida

A comparison of the study's results with existing conservation policies in Northeast Florida can yield an evaluation of the appropriateness of the policies in an economic sense. That is, whether programs such as Florida Forever reflect residents' WTP for conservation alternatives as described here. A total of $190.3M has been spent to date to purchase 83,449 acres of conservation lands as part of the seven projects in Northeast Florida on the priority list (Table 7-7). A total of $318.5M is the projected cost of acquiring the remaining 267,535 project acres, an amount similar to the greatest quantity of land presented to respondents in the choice experiments, 250,000 acres. The stated goals of the Florida Forever projects also include the focus attribute levels presented in the study (water and wildlife are of particular interest to the region's projects), and as such a comparison can be made if the statewide nature of the Florida Forever program and the temporal aspect of land acquisition are first addressed.

Funding for Florida Forever comes from revenue collected statewide and this must be taken into consideration when evaluating its efficacy. It is reasonable to assume that Floridians outside of the four-county region that is the setting for this study also value the conservation lands in Northeast Florida. This may be because they plan to visit such sites themselves, especially if they live in close proximity, or perhaps because the ecosystem service flows provided by such landscapes are not exclusive to residents of Northeast Florida. People also place a value on the existence of natural landscapes, flora, and fauna although they may never directly behold them. It is likely that there would be

Table 7-7: Florida Forever projects in Northeast Florida

Project Name	Year listed	Acreage			Cost ($)		
		Acquired	Remaining	Project total	Acquired	Remaining[b]	Project total
Cedar Swamp	2001	2,372	2,064	4,435	36,785,000	2,598,503	39,383,503
NE Florida Blueway	2001-2	8,671	26,348	35,019	30,404,950	25,821,040	56,225,990
NE FL Timberlands and Watershed Reserve[a]	2001	25,088	114,759	139,847	72,827,735	41,442,723	114,270,458
Pumpkin Hill Creek	1994	4,175	19,126	23,301	9,387,230	15,740,761	25,127,991
St. Johns River Blueway	2002	-	27,997	27,997	-	58,229,721	58,229,721
Twelve Mile Swamp	1992	21,717	8,845	30,562	22,477,599	1,012,865	23,490,464
Etoniah/Cross Florida Greenway[a]	1995	21,426	68,396	89,822	18,362,718	173,648,234	192,010,952
Total		**83,449**	**267,535**	**350,983**	**190,245,232**	**318,493,847**	**508,739,079**

[a] portion of project acreage (10% or less) lies outside of four-county study area; acquisitions outside study area to date very limited.
[b] estimate based on tax assessed value.
Source: Florida Department of Environmental Protection Division of State Lands 2004.

little public support for statewide conservation programs if Floridians did not hold values for the conservation of landscapes outside their immediate vicinity.

While the present study does not determine the WTP of Floridians outside the study area, if theirs is taken to be a small fraction of the WTP of Northeast Florida residents the statewide WTP for conservation alternatives can be estimated. Caution must be taken in discussing such an estimate since it makes an inference about preferences of residents outside the sample area. It further infers a value placed on a different scenario: the value of conservation alternatives in another region as opposed to conservation alternatives implemented in the respondents' region. Nevertheless such an evaluation is of some use in discussing this statewide program where statewide data is lacking provided that appropriate caveats are applied when making any assertions.

Statewide annual WTP for 250,000-acre conservation alternatives was estimated by assigning values of 1%, 5%, and 10% of survey respondents' WTP to the 5,954,849 Florida households outside the Northeast region (Table 7-8). For plans with a water or wildlife focus where all conserved acres are purchased, the closest analogs to the Florida Forever projects in the region, statewide annual WTP ranged from $13.9M to $37.6M.

Since extensive conservation programs typically are of multiple-year duration, the annual WTP can be multiplied by a representative number of years and compared to the program's budget. The lifespan of the Florida Forever program is 2000-10, meaning that less than seven years remain before it expires. The maximum statewide WTP for conservation alternatives over a seven-year period is $262.9M (water focus, all purchase, rest of Florida households with WTP 10% that of respondents), considerably less than the $318.5M outlay anticipated for purchasing the remaining acreage. While the estimate of

Table 7-8: Statewide estimated willingness to pay for selected 250,000 acre conservation plans.

	Northeast Florida			Rest of Florida			Statewide total		
	Annual	5 yr. total	10 yr. total	Annual	5 yr. total	10 yr. total	Annual	5 yr. total	10 yr. total
R.O.F. 1% valuation [a]									
Water, all purchase	15,838,945	79,194,724	158,389,448	2,171,865	10,859,325	21,718,650	18,010,810	90,054,049	180,108,098
Water, 1/2 purchase	18,899,358	94,496,791	188,993,582	2,591,514	12,957,572	25,915,144	21,490,873	107,454,363	214,908,726
Wildlife, all purchase	12,258,419	61,292,097	122,584,194	1,680,897	8,404,484	16,808,968	13,939,316	69,696,581	139,393,162
Wildlife, 1/2 purchase	15,318,833	76,594,164	153,188,328	2,100,546	10,502,731	21,005,463	17,419,379	87,096,895	174,193,790
R.O.F. 5% valuation									
Water, all purchase	15,838,945	79,194,724	158,389,448	10,859,325	54,296,624	108,593,248	26,698,270	133,491,348	266,982,696
Water, 1/2 purchase	18,899,358	94,496,791	188,993,582	12,957,572	64,787,860	129,575,721	31,856,930	159,284,651	318,569,303
Wildlife, all purchase	12,258,419	61,292,097	122,584,194	8,404,484	42,022,420	84,044,840	20,662,903	103,314,517	206,629,034
Wildlife, 1/2 purchase	15,318,833	76,594,164	153,188,328	10,502,731	52,513,656	105,027,313	25,821,564	129,107,820	258,215,640
R.O.F. 10% valuation									
Water, all purchase	15,838,945	79,194,724	158,389,448	21,718,650	108,593,248	217,186,496	37,557,594	187,787,972	375,575,944
Water, 1/2 purchase	18,899,358	94,496,791	188,993,582	25,915,144	129,575,721	259,151,442	44,814,502	224,072,512	448,145,024
Wildlife, all purchase	12,258,419	61,292,097	122,584,194	16,808,968	84,044,840	168,089,680	29,067,387	145,336,937	290,673,874
Wildlife, 1/2 purchase	15,318,833	76,594,164	153,188,328	21,005,463	105,027,313	210,054,625	36,324,295	181,621,476	363,242,953

[a] R.O.F.: rest of Florida.

statewide WTP falls short of the estimated acquisition costs of the seven projects' remaining acreage, it does appear to be within a reasonable realm. If it is assumed that the conservation strategy is half purchase – half conservation agreement (along with water focus and 10% of regional WTP for the rest of Florida), the seven year total is $313.7M, a total that closely approaches the $318.5M projected acquisition cost. It must again be emphasized that the values of the rest of Florida are speculative, and that the maximum statewide WTP estimated here may be well above (if Floridians' WTP is closer to the 1% end of the spectrum) or below its actual value (if Floridians' WTP exceeds the 10% valuation).

CHAPTER 8
SUMMARY AND CONCLUSIONS

Definition of the trade-offs associated with alternative land uses in Northeast Florida is important to sound decision-making about land use change in the face of population growth. Ecosystem goods and services arising from the landscape are important to many residents' quality of life and are an important element in the local economy. This study provides information about residents' preferences for a set of ecosystem services originating from extensive land uses in the region, as well as residents' preferences regarding conservation strategies aimed at ensuring their ongoing provision.

A choice experiment was designed to assess these preferences and was implemented via a mail survey. The choice experiment consisted of two alternative conservation plans and an opt out alternative. The alternative plans contained four attributes: quantity of land, focus of the plan, type of protection afforded by the plan, and annual cost of the plan. The choice experiment sought to capture the complexity of issues related to land use and the ecosystem services in question while providing respondents with a manageable cognitive task. The survey instrument contained a brief introduction to the topic, a preliminary focus question, instructions for the completion of the choice task, nine choice sets, and a final page soliciting socioeconomic and demographic information. The survey instrument and supporting documents were sent to 5,000 randomly selected households in Clay, Duval, Putnam, and St Johns counties in the spring of 2004; 945 usable responses were returned.

Responses to the choice experiment were analyzed using the Heckman two-step procedure. The first step of the procedure indicated that age, income, and land ownership influence respondents' decision to choose a conservation alternative versus choosing the status quo situation. The second step of the procedure indicated that respondents prefer conservation alternatives with a focus on water quality and quantity provision, a combination of land purchases and conservation agreements over each strategy individually, lower annual cost, and greater acreage.

Annual household WTP for the various attribute levels relative to a baseline scenario of the purchase of 10,000 acres with a focus on water quality ranged from $36.53 to -$32.33. Annual WTP for specific conservation alternatives presented ranged from $43.59 to -$40.95 on a household level, and $18.9M to -$17.8M on a regional level. The study's WTP results were extended to a statewide level in order to provide an evaluation of Florida Forever projects in the area. The maximum WTP for the conservation alternatives presented in the study over seven years was substantially less than the projected cost of acquiring a similar quantity of land.

The study sends the message to the conservation community that a considerable demand exists for landscape conservation in Northeast Florida. The acceptability of less than fee-simple acquisitions is acceptable to the public, and a combination of such agreements with fee simple purchases was in fact the most favorable conservation strategy for respondents. This validation is significant because conservation easements or leases provide flexibility in landscape conservation and present certain advantages over fee simple purchases. While the sample population in the study is not entirely representative of the region's population, the fact that nearly 90% of respondents voted in

recent elections implies that the survey provides a good indication of support for conservation initiatives if brought to a vote. The study does provide some indication that Florida Forever is an appropriate program in scope and scale. Information about Floridians' preferences for conservation alternatives within and outside their region would not be difficult to acquire and would provide more solid evidence as to whether Florida Forever is on target.

APPENDIX A
CORRESPONDENCE AND SURVEY INSTRUMENT

All respondents received a series of four mailings: a preliminary notification letter, the survey instrument and accompanying cover letter, a reminder postcard, and a replacement questionnaire with accompanying cover letter.

Object A1: Preliminary letter

Object A2: Questionnaire cover letter

Object A3: Survey instrument

Object A4: Reminder postcard

Object A5: Replacement questionnaire cover letter

APPENDIX B
EXPERIMENTAL DESIGN AND SAS CODE

```
options ls=75;
%mktdes(factors=x1-x4=3 f1-f2=1, run=factex)

proc print;

%choiceff(data=cand1, model=class(x1-x4), nsets=27,
flags=f1-f2, beta=zero, maxiter=10);

proc print;


run;
```

ChoiceIndex		Set	quant	focus	ptype	cost
set						
A1	23	18	3	2	2	3
A1	1	18	1	1	1	1
A2	11	7	2	1	2	2
A2	25	7	3	3	1	3
A3	18	14	2	3	3	2
A3	22	14	3	2	1	1
A4	19	12	3	1	1	2
A4	15	12	2	2	3	3
A5	12	21	2	1	3	1
A5	7	21	1	3	1	2
A6	9	16	1	3	3	3
A6	22	16	3	2	1	1
A7	21	4	3	1	3	3
A7	14	4	2	2	2	1
A8	27	27	3	3	3	1
A8	4	27	1	2	1	3
A9	20	17	3	1	2	1
A9	7	17	1	3	1	2
B1	16	23	2	3	1	1
B1	21	23	3	1	3	3
B2	1	3	1	1	1	1
B2	23	3	3	2	2	3
B3	4	9	1	2	1	3
B3	18	9	2	3	3	2
B4	13	15	2	2	1	2
B4	2	15	1	1	2	3
B5	19	5	3	1	1	2
B5	6	5	1	2	3	1
B6	24	10	3	2	3	2
B6	8	10	1	3	2	1
B7	5	26	1	2	2	2

B7	16	26	2	3	1	1
B8	22	2	3	2	1	1
B8	3	2	1	1	3	2
B9	10	1	2	1	1	3
B9	8	1	1	3	2	1
C1	27	24	3	3	3	1
C1	10	24	2	1	1	3
C2	24	19	3	2	3	2
C2	2	19	1	1	2	3
C3	17	20	2	3	2	3
C3	3	20	1	1	3	2
C4	26	25	3	3	2	2
C4	12	25	2	1	3	1
C5	11	13	2	1	2	2
C5	9	13	1	3	3	3
C6	13	6	2	2	1	2
C6	20	6	3	1	2	1
C7	6	8	1	2	3	1
C7	17	8	2	3	2	3
C8	15	22	2	2	3	3
C8	26	22	3	3	2	2
C9	25	11	3	3	1	3
C9	5	11	1	2	2	2

Key:
Quant 1=10,000 ac, 2=100,000 ac, 3=250,000 ac
Focus 1=water, 2=wildlife, 3=open space
Ptype 1=all purchase, 2=half purchase, half coop, 3=all coop agrmt.
Cost 1=$5, 2=$25, 3=$50

APPENDIX C
TSP CODE USED FOR DATA ANALYSIS

```
OPTIONS MEMORY=100;

FREQ NONE;

LIST ZVARZ

Form    Subj    Case    CH      ZZ  WW  ZW
AA      BB      N1      CC      DD      N2      EE      FF      N3
GG      HH      N4      II      JJ      N5      KK      LL      N6
MM      NN      N7      OO      PP      N8      QQ      RR      N9
F1      F2      F3      F4
P1      P2      P3      P4
QTY     Q1      Q2      Q3      Q4
COST    AC1     AC2     AC3     AC4
PSQ     PQ1 PQ2 PQ3
SEX     YRB     AGE     EDU     RES     RYR
OWN     LND     VPR     VLC     NHH     EMP     INC     REM;


OUT 'C:\Documents and Settings\bmcondon\Desktop\TSP\NEFLABC';
SMPL 1,7668;
READ(FORMAT=EXCEL,FILE='C:\Documents and
Settings\bmcondon\Desktop\TSP\NEFLFINALA2.XLS');

SMPL 7669,16983;
READ(FORMAT=EXCEL,FILE='C:\Documents and
Settings\bmcondon\Desktop\TSP\NEFLFINALB2.XLS');

SMPL 16984,25515;
READ(FORMAT=EXCEL,FILE='C:\Documents and
Settings\bmcondon\Desktop\TSP\NEFLFINALC2.XLS');

SMPL 1,255515;

SET NOB=@NOB;
IDD=1;
SMPL 2,NOB;
IDD=IDD(-1)*(CASE=CASE(-1)) + ( IDD(-1)+1 )*(CASE^=CASE(-1));
SMPL 1,NOB;
OUT;

DBLIST 'C:\Documents and Settings\bmcondon\Desktop\TSP\NEFLABC';

END;
```

```
OPTIONS MEMORY=50;

FREQ NONE;
TITLE 'HECKMAN';
LIST ZVARZ

Form    Subj    Case    CH      ZZ   WW  ZW
AA      BB      N1      CC      DD      N2      EE      FF      N3
GG      HH      N4      II      JJ      N5      KK      LL      N6
MM      NN      N7      OO      PP      N8      QQ      RR      N9
F1      F2      F3      F4
P1      P2      P3      P4
QTY     Q1      Q2      Q3      Q4
COST    AC1     AC2     AC3     AC4
PSQ     PQ1 PQ2 PQ3
SEX     YRB     AGE     EDU     RES     RYR
OWN     LND     VPR     VLC     NHH     EMP     INC     REM;

IN 'C:\Documents and Settings\bmcondon\Desktop\TSP\NEFLABC';

INCL=(INC<=6)+(INC>6)*2;
DUMMY INCL;
DOT 2;
DINCL.=INCL.-INCL1;
ENDDOT;

EDUL=(EDU<=3)+(EDU>4)*2;
DUMMY EDUL;
DOT 2;
DEDUL.=EDUL.-EDUL1;
ENDDOT;

DOT SEX RES OWN LND VPR VLC;
X.=.;
ENDDOT;

DUMMY EDU;  ? 5 VALUES;
DUMMY PSQ;  ? 3 VALUES;
DUMMY SEX;  ? 0 FEMALE 1 MALE;
DUMMY RES;  ? 1 RESIDENT 0 NO;
DUMMY OWN;  ? 1=OWN 0=RENT;
DUMMY LND;  ? 1=OWN LAND 0 NO;
DUMMY VPR;  ? 1=VOTED 0=NO - PRESIDENTIAL;
DUMMY VLC;  ? 1=VOTED 0=NO - LOCAL ELECTIONS;
DUMMY INC;  ? 9 GROUPS IN $10,000;

DOT 2-5; DEDU.=EDU. - EDU1; ENDDOT;
DOT 2-9; DINC.=INC. - INC1; ENDDOT;
DOT 2-3; DPSQ.=PSQ. - PSQ1; ENDDOT;

DOT(CHAR=#) SEX RES OWN LND VPR VLC;
D.#2 = .#2-.#1;
ENDDOT;

DOT(CHAR=#) F P Q AC;
```

```
DOT(CHAR=%) 2 3;
D.#.%= .#.% - .#1;
ENDDOT;
ENDDOT;


PROBIT ZZ C DF2 DF3 DP2 DP3 QTY COST DSEX2 DOWN2 DLND2 DEDUL2 DINCL2;
IM=@MILLS;

SELECT ZW=1;

LOGIT(CASE=IDD) CH DF2 DF3 DP2 DP3 QTY COST | C IM DSEX2 DOWN2 DLND2 DEDUL2
DINCL2 AGE;

END;
```

APPENDIX D
SURVEY RESPONSE DATA

Object D1: Survey sample data – Excel format

Object D2: Survey sample data – CSV format

LIST OF REFERENCES

Adamowicz,W.L., Louviere,J., and Williams,M., 1994. Combining revealed and stated preference methods for valuing environmental amenities. Journal of Environmental Economics and Management 26, 271-292.

Adamowicz,W.L., Swait,J., Boxall,P.C., Louviere,J., and Williams,M., 1997. Perceptions versus objective measures of environmental quality in combined revealed and stated preference models of environmental valuation. Journal of Environmental Economics and Management 32, 65-84.

Adamowicz,W.L., Boxall,P.C., Williams,M., and Louviere,J., 1998. Stated preference approaches for measuring passive use values: choice experiments and contingent valuation. American Journal of Agricultural Economics 80, 64-75.

Alvarez-Farizo,B. and Hanley,N., 2002. Using conjoint analysis to quantify public preferences over the environmental impacts of wind farms. An example from Spain. Energy Policy 30, 107-116.

Bauer,D.M., Cyr,N.E., and Swallow,S.K., 2004. Public preferences for compensatory mitigation of salt marsh losses: a contingent choice of alternatives. Conservation Biology 18, 401-411.

Boxall,P.C., Adamowicz,W.L., Swait,J., Williams,M., and Louviere,J., 1996. A comparison of stated preference methods for environmental valuation. Ecological Economics 18, 243-253.

Boyle,K.J., Holmes,T.P., Teisl,M.F., and Roe,B., 2001. A comparison of conjoint analysis response formats. American Journal of Agricultural Economics 83, 441-454.

Costanza,R., d'Arge,R., de Groot,R., Farber,S., Grasso,M., Hannon,B., Limburg,K.E., Naeem,S., O'Neill,R.V., Paruelo,J., Raskin,R.G., Sutton,P.C., and Villa,F., 1997. The value of the world's ecosystem services and natural capital. Nature 387, 253-259.

de Groot,R.S., Wilson,M.A., and Boumans,R.M.J., 2002. A typology for the classification, description and valuation of ecosystem functions, goods and services. Ecological Economics 41, 393-408.

DeFries,R.S., Foley,J.A., and Asner,G.P., 2004. Land-use choices: balancing human needs and ecosystem function. Frontiers in Ecology and the Environment 2, 249-257.

DeShazo,J.R. and Fermo,G., 2002. Designing Choice Sets for Stated Preference Methods: The Effects of Complexity on Choice Consistency. Journal of Environmental Economics and Management 44, 123-143.

Dillman,D.A., 2000. Mail and internet surveys: the Tailored Design Method. John Wiley & Sons, Inc., New York, USA.

Duke,J.M. and Aull-Hyde,R., 2002. Identifying public preferences for land preservation using the analytic hierarchy process. Ecological Economics 42, 131-145.

Farber,S.C., Costanza,R., and Wilson,M.A., 2002. Economic and ecological concepts for valuing ecosystem services. Ecological Economics 41, 375-392.

Flores,N.E., 2003. Conceptual framework for nonmarket valuation. In: P.A.Champ, K.J.Boyle, and T.C.Brown (Editors), A primer on nonmarket valuation. Kluwer Academic Publishers, Dordrecht, The Netherlands, pp. 27-58.

Florida Department of Elections, 2004. Voter turnout percentages. Available at http://election.dos.state.fl.us/online/voterpercent.shtml. Last accessed 6-10-2004.

Florida Department of Environmental Protection Division of State Lands, 2004. Florida Forever Five Year Plan. Tallahassee, FL.

Freeman,A.M.I., 1993. The measurement of environmental and resource values: theory and methods. Resources for the Future, Washington, D.C.

Freeman,A.M.I., 2003. Economic valuation: what and why. In: P.A.Champ, K.J.Boyle, and T.C.Brown (Editors), A primer on nonmarket valuation. Kluwer Academic Publishers, Dordrecht, The Netherlands, pp. 1-26.

Greene, W.H., 2003. Econometric analysis. Prentice Hall, Upper Saddle River, New Jersey.

Hanemann,W.M., 1984. Welfare evaluations in contingent valuation experiments with discrete responses. American Journal of Agricultural Economics 66, 332-341.

Hanemann,W.M., 1994. Valuing the environment through contingent valuation. Journal of Economic Perspectives 8, 19-44.

Hanley,N., Wright,R.E., and Adamowicz,V., 1998. Using choice experiments to value the environment. Environmental and Resource Economics 11, 413-428.

Hanley,N., Mourato,S., and Wright,R.E., 2001. Choice modeling approaches: a superior alternative for environmental valuation? Journal of Economic Surveys 15, 435-462.

Howarth,R.B. and Farber,S., 2002. Accounting for the value of ecosystem services. Ecological Economics 41, 421-429.

Johnston,R.J., Opaluch,J.J., Grigalunas,T.A., and Mazzota,M.J., 2001. Estimating amenity benefits of coastal farmland. Growth and Change 32, 305-325.

Kahneman,D. and Knetsch,J.L., 1992. Valuing public goods: the purchase of moral satisfaction. Journal of Environmental Economics and Management 22, 57-70.

Krinsky,I. and Robb,A.L., 1986. On approximating the statistical properties of elasticities. Review of Economics and Statistics 68, 715-719.

Kuhfeld,W.F., Tobias,R.D., and Garratt,M., 1994. Efficient experimental design with marketing research applications. Journal of Marketing Research 31, 545-557.

Kuhfeld, Warren F., 2001. Multinomial logit, discrete choice modeling. TS-650E. SAS Institute.

Long,J.S., 1997. Regression models for categorical and limited dependent variables. Sage Publications, Inc., Thousand Oaks, California.

Louviere,J. and Hensher,D.A., 1983. Using discrete choice models with experimental design data to forecast consumer demand for a unique cultural event. Journal of Consumer Research 10, 348-361.

Louviere,J., 1988. Analyzing decision making: metric conjoint analysis. Sage Publications, Newbury Park, CA.

Louviere,J., 1992. Experimental choice analysis: introduction and overview. Journal of Business Research 24, 89-96.

Louviere,J., Hensher,D.A., and Swait,J., 2000. Stated choice methods. Cambridge University Press, Cambridge, UK.

Manski,C.F., 2000. Economic analysis of social interactions. Journal of Economic Perspectives 14, 115-136.

McFadden,D., 1986. The Choice Theory Approach to Market Research. Marketing Science 5, 275-297.

Milon, J. Walter, Hodges, Alan W, Rimal, Arbindra, Kiker, Clyde F, and Casey, Frank. Public preferences and economic values for restoration of the Everglades/south Florida ecosystem. 99-1. 1999. Gainesville, FL, Food and Resource Economics Department, University of Florida.

Minnesota Implan Group, 2000. Implan data for Florida counties. Minneapolis, MN.

Nord,M. and Cromartie,J.B., 1997. Migration: the increasing importance of rural natural amenities. Choices 12, 22-23.

Power,T.M., 1996. Lost landscapes and failed economies: the search for a value of place. Island Press, Washington, D.C.

Ready,R.C., Berger,M.C., and Blomquist,G.C., 1997. Measuring amenity benefits from farmland: hedonic pricing vs. contingent valuation. Growth and Change 28, 438-458.

Southwest Florida Regional Planning Commission, 1994. North Florida future land use. Available at http://www.fgdl.org/download/download.html. Last accessed 7-12-2004.

St Johns River Water Management District, 1999. Land use / land cover 1995. Available at http://arcimspub.sjrwmd.com/metadataindex/. Last accessed 7-16-2004.

St Johns River Water Management District, 2003. Florida Forever work plan annual update. Available at http://sjr.state.fl.us/programs/outreach/pubs/index.html. Last accessed 7-12-2004.

St Johns River Water Management District, 2004. Land use / land cover 2000. Available at http://arcimspub.sjrwmd.com/metadataindex/. Last accessed 7-12-2004.

Swallow,S.K., Weaver,T., Opaluch,J.J., and Michelman,T.S., 1994. Heterogeneous preferences and aggregation in environmental policy analysis: a landfill siting case. American Journal of Agricultural Economics 76, 431-443.

University of Florida Bureau of Economic and Business Research, 2002. 2002 Florida statistical abstract. University of Florida, Gainesville, FL.

University of Florida Bureau of Economic and Business Research, 2003a. Number of households and average household size in Florida: April 1, 2002. Florida Population Studies 36, 1-4.

University of Florida Bureau of Economic and Business Research, 2003b. Florida Estimates of Population 2002. University of Florida, Gainesville, FL.

University of Florida Bureau of Economic and Business Research, 2004. Population projections by age, sex, and race for Florida and its counties, 2002-2025. Florida Population Studies 36.

van Kooten,G.C. and Bulte,E.H., 2000. The economics of nature: managing biological assets. Blackwell Publishers Ltd., Oxford, Great Britain.

BIOGRAPHICAL SKETCH

Brian Condon received his B.S. in natural resource and environmental science from the University of Illinois in 1993. After graduation, Brian worked on various ecology projects and as a forestry contractor in several western states. In 1995 he went to Paraguay as a Peace Corps volunteer in the agroforestry extension program. Upon completion of his service, Brian was a founding member and served as Development Director for Servicios Ecoforestales para Agricultores, SEPA, a local nonprofit organization created by a group of Peace Corps volunteers and Paraguayan nationals. Brian worked in the field of local development and agroforestry extension with SEPA until 2001, when he returned to the U.S. He will be pursuing a PhD in food and resource economics beginning in the fall of 2004, and is an IGERT Fellow in the Working Forests in the Tropics program.